

A full-page photograph of an Antarctic landscape. The sky is a deep, dark blue with a bright, glowing sun or moon in the upper center, creating a lens flare effect. Below the sky, there are layers of white and light blue clouds. The horizon line is low, showing a flat, icy expanse. In the lower-left foreground, a small, dark silhouette of a person stands on the ice, looking out towards the horizon. The overall mood is vast, cold, and serene.

ANTARCTICA

SCIENCE SERVICE

SCIENCE PROGRAM

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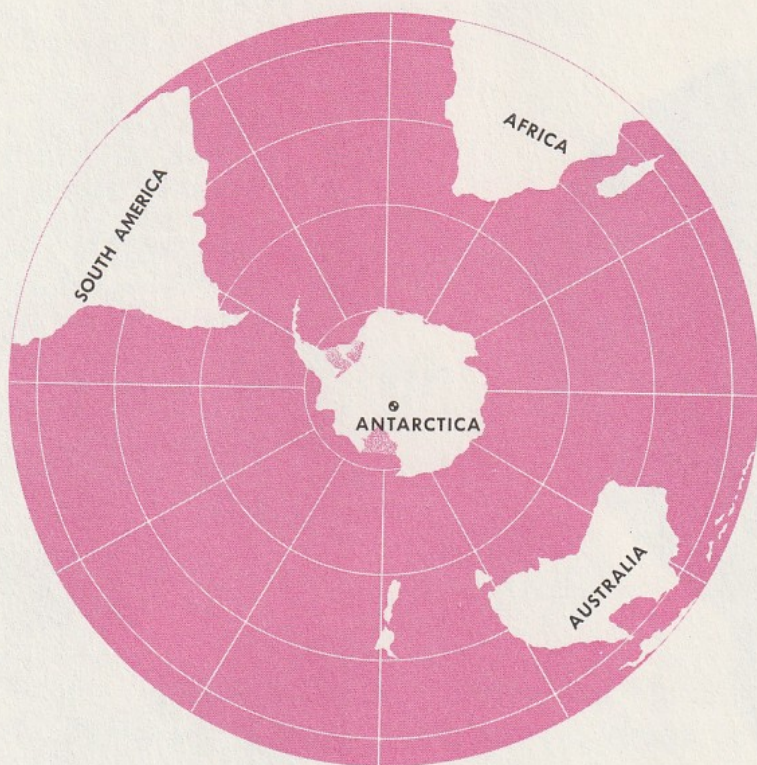
SCIENCE PROGRAM

*Prepared with the co-operation of
Science Service*

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Entombed in Ice

FOR THOUSANDS OF YEARS man has wandered, explored and settled himself over the earth. From the arid deserts of the world to the fringes of the ice-clad Arctic and to the jungles of the Amazon and Congo, man has adapted himself to a variety of harsh and challenging climates. One great region of the world, however, has not yet been tamed by man, at least not on a large scale. It is Antarctica, land of the South Pole and the fifth-largest of the world's seven great continental land masses.

Remote and inhospitable, this wild and lonely continent has only in fairly recent times felt the foot of civilized man—but mostly through thousands of feet of protecting ice. Except for information gained by the scientific techniques of seismology and gravity, and excepting a few exposed fringes of the continent, her true landscape has never been viewed by man.

Antarctica is a place of unusual and striking contrasts. This land at the bottom of the world has, for the most part, remained unchanged for at



least 170,000 years, trapped beneath a vast breastplate of ice. It is the coldest and windiest area on the face of the earth. The frigid winds sometimes howl down the lofty icecap at 200 miles an hour and sweep over the surrounding iceberg-laden seas. The surface temperature in the interior has plunged as low as -126.9°F. , recorded by Soviet scientists on 24 August, 1960. Entombed in ice, the continent is virtually lifeless, except for patches of moss and lichen that cling to the few uncovered rocks. Yet in some areas in the surrounding waters there is more living matter per acre than anywhere else on our planet.

Today, against the background of Antarctica's wild landscape and frigid grandeur, a revolution of sorts is taking place. This far-flung outpost has become the scene of a remarkable experiment in international co-operation. It is a strange sight indeed to see one country voluntarily



turn over to another a scientific base that has cost millions of dollars to plan, equip and maintain. Yet this is becoming standard practice. By mutual accord among nations, Antarctica has been set aside as a special preserve for peaceful development. War has been outlawed there, nuclear weapons banned. Inspection is open and free. In ice age conditions, a population of scientists is working for the benefit of all mankind.

A Continent Covered with Ice

THE GREATER PART OF ANTARCTICA is a huge plateau—an enormous layer of ice more than three miles thick in some places, formed by



1.

PRESSURE ICE

The strange formation here is pressure ice, formed when moving ice encountered stationary bay ice, and forced up these pressure ridges. Since ice moves very slowly, many of these formations remain unchanged for years.



thousands of years of snow accumulation. This ice plateau slopes down to the coast, and great chunks of ice, which become icebergs, are continually breaking off and plunging into the sea on all sides. If all of the continent's ice should melt suddenly, the world's shorelines would be flooded, drowning ports and coastal lowlands under at least 200 feet of water.

With its covering of snow and ice, the continent's outline resembles a pear in shape, except for a peninsula extending beyond the Antarctic Circle. We are just now beginning to learn its true contour and how it would look if there were no ice. If we could see Antarctica without its icecap, we would find an ordinary land mass of islands, mountains, valleys and plains. During the International Geophysical Year, the continent was found to have two distinct sections separated by a trough connecting the Ross and Bellingshausen seas. Through echo soundings and magnetometer surveys, a few shorelines have been plotted, showing buried fiords more than 2,500 feet below sea level, flanked by mountains whose 4,200-foot-high peaks just poke their tips above the continuous plain of snow.

The massive mountains that skirt much of the coastline run inland, until they become submerged beneath the huge ice plateau—larger than all of Europe. But even inland, some of the major mountain peaks occasionally protrude through the monstrous ice roof; some of them tower 15,000 feet above sea level. This bleak interior is the loftiest of the world's continents, twice as high in average elevation as Asia. In remarkable contrast to the white desolation, one coastal mountain—12,450-foot-high Mt. Erebus, an active volcano—gives off a plume of smoke and steam.

Inland there is neither moisture nor decay; it is like an enormous deep freeze. Because of the continent's lofty ice, the air over it is chilled and rushes down into the surrounding seas to make them the stormiest in the world. This cold air, as it circulates over the rest of the earth, is believed to affect the general world temperature—but to what extent, we do not yet know.

The south polar plateau, being land, is much colder than the Arctic, and cannot absorb and retain as much heat as the watery North Pole, which is in the Arctic Ocean. The South Pole lies exposed on the great ice plateau, nearly 10,000 feet above sea level. The Antarctic winter begins in June, and the brief four- to eight-week summer begins in November. As one approaches the South Pole, time zones and longitudes converge. At the Pole itself, "daily time" is a fiction, and when the sun can be seen at all it is always "due north". But for half the entire year the sun is below the horizon. The Antarctic ice sheet, seemingly stationary, is actually a continuous, moving mass. The ice flows and finds its own level, just as water does, only much more slowly.

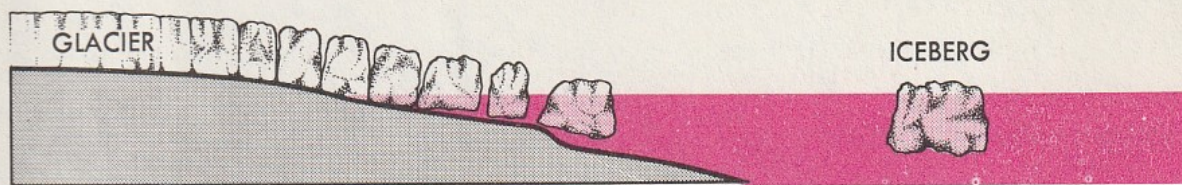
Glaciers—"rivers" of flowing ice—slice through the plains of slower moving ice, although neither appears to the human eye to be moving at



all. One of these better known rivers, Beardmore Glacier, is more than twelve miles wide and one hundred miles long and flows down a mountain pass toward the sea. It has been estimated that ice from the top of this massive glacier, at its present rate of movement, will take 1,200 years to reach the sea. Some of the glacial rivers have "rapids", and although their movement is not visible, it makes the ice groan, creak and thunder like distant artillery. Added to this is the frequent howling and shrieking of the wind with the ferocity of a blizzard. On rare occasions, a few days during the summer, the wind temporarily ceases its cascade of noise, and the sudden eerie silence is striking.

The strong winds sculpture the ice and snow into strange shapes, so that the ice sheet is often anything but smooth. The snow that falls on the continent is not the soft velvety flake familiar in more temperate zones. Antarctic snow is in the form of tiny roundish grains which, when driven by wind, sting the bare skin. Before it is packed into ice, this form of snow gives the continent an appearance of a great white desert of sand, but "sand" that is constantly slipping into the surrounding sea. In places the ice extends many miles beyond the true coast and forms a shelf over the surrounding waters. The fact that the ice edge changes year by year creates one of the difficulties in determining the continent's true outline.





Antarctica's Ice Shelves

THE ICE SHELVES ARE a matchless feature of Antarctica. One great mass—the Ross Ice Shelf—covers a gulf in the Ross Sea and is larger than the whole of France. It fronts the ocean for 400 miles and extends 500 miles outward from the mountainous shore. The ice shelves are merely the extension of the Antarctic ice cap, which flows out from the continent; the ice is thick and in addition is supported by ocean water, so that it can extend out from land for great distances. Near some of the islands and near shore, the ice shelves may rest on the rock floor. When approached from the sea, this queer “shoreline” appears as ice cliffs rising more than eighty feet above the water line. In magnificent, unbroken uniformity it stretches as far as the eye can see.

Ice that breaks off from the shelves forms the flat-topped icebergs typical of the Antarctic. Occasionally giant fragments can occur, some up to 700 feet thick and 100 miles long. Along different sections of the coast, ice “calves” off and plunges into the sea, leaving the coast with a new shape. Mighty cracking and thundering sounds come from the ice as it breaks off at the edges.

While the ice of the continent itself has often kept explorers at a respectful distance, the rim of drifting pack ice surrounding Antarctica has been an obstacle to ships approaching the continent. This wandering pack is made up of ice that has drifted out from the continent and packed together in the open sea during winter—sometimes freezing to a thickness of ten feet or more. The girdling pack ice forms a barrier up to 600 miles wide, but with clear sea on either side of it. In summer, however, when parts of the pack melt, ships are able to sail through more or less freely.

It is in and around the pack ice that the continent's animal and plant life abounds. In contrast to the almost lifeless desolation of the mainland, the near-freezing ocean around the pack ice is a luxuriant pasture. All living creatures depend on this life-giving sea, some going ashore to the continent only to breed.



Three U.S. icebreakers move a huge iceberg from the channel leading to McMurdo Sound.

One-celled plants called diatoms thrive in the cold waters and serve as the basic link in the chain of life. But the water is filled with a jungle of other minute creatures as well. Crustacea and mollusks feed on this undersea life, and themselves serve as a link in the food chain for larger creatures such as squid, and huge jellyfish that weigh as much as ninety pounds. It is a constant battle for existence; penguins feeding on the fish; sea-leopards, a form of seal, hunting the penguins and in turn being hunted by the killer whales. Antarctica has a tremendous assortment of bird life, ranging from the graceful, legendary wandering albatross (with a wing span up to twelve feet) to the gluttonous petrels and to the nonflying penguins—"little old gentlemen in evening dress", as the French explorer Dumont d'Urville described them.

The blue whale, largest animal in the world, 150 tons and more than 100 feet long, makes its home in the Antarctic waters and feeds on the shrimplike krill; its chief enemy is the smaller killer whale, the most vicious animal in the Antarctic. Rarely more than twenty feet long, which

is small as whales go generally, the killer whales prey mainly on seals and porpoises, but all creatures flee from them.

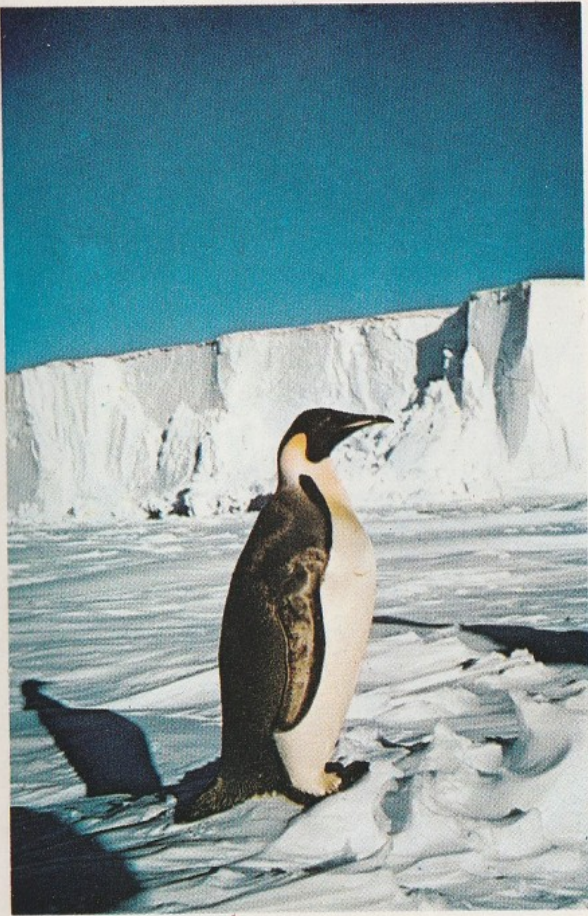
The killer whale pops its head out of the water in search of a penguin or a basking seal. When it spots a victim, it dives under the ice and charges straight up, bumping the ice from below. Usually this trick smashes the ice and either tumbles or frightens the victims into the sea. Killer whales have been said to use the same strategy against men walking along the ice.

In addition to the isolated patches of coarse lichen and moss found on the mainland, a few species of insects have also been observed. These



2. ICEBREAKER "U.S.S. STATEN ISLAND"

The technique of breaking ice is to ram the ice at full speed, thus lifting the whole ship onto the ice, which then breaks under the weight for about 100 feet. The ship backs off and the whole process is repeated for mile after mile.



3.

EMPEROR PENGUIN

The Emperor penguin is the largest species of these peculiar birds. The females lay only one egg a year and these are incubated by either parent in a standing-up position with the egg resting on the feet and covered by feathery muffs.

remain solidly frozen throughout their lives, except for short periods each summer when they thaw and reproduce. Some algae and plant life have also been found in the fresh water that occupies some of the rare snow-free valley bottoms.

The most striking result of Antarctic research is our knowledge that the continent has not always been frozen in an icy slumber. There is evidence that this white wasteland once supported flourishing Carboniferous, Permian and Jurassic vegetation that grew luxuriantly in a tropical climate hundreds of thousands of years ago. Petrified logs have been found buried under the ice; beds of coal representing ancient forests have been uncovered; fossils of pine trees, leaves and twigs dating back to times when dinosaurs roamed the earth have been discovered. To date, we have

no evidence that true land animals ever roamed the continent. We have only a picture of an Antarctica once green and dense with rain forests—a heavy growth of fig trees, laurel, beech, sequoia and araucaria, some of which still grow today in South America and the South Seas. Such evidence suggests that Antarctica might have been linked with other continents in the great primitive “super continent” that geologists call Gondwana land.

In Search of a Continent

THE TRUE ANTARCTICA CONTINENT was not sighted until the early nineteenth century. Nevertheless, hundreds of years earlier many men believed that the Southern Hemisphere *must* contain a great land mass that “balances” the land mass in the Northern Hemisphere. So firm

Two seals lie basking in the Antarctic sunshine.



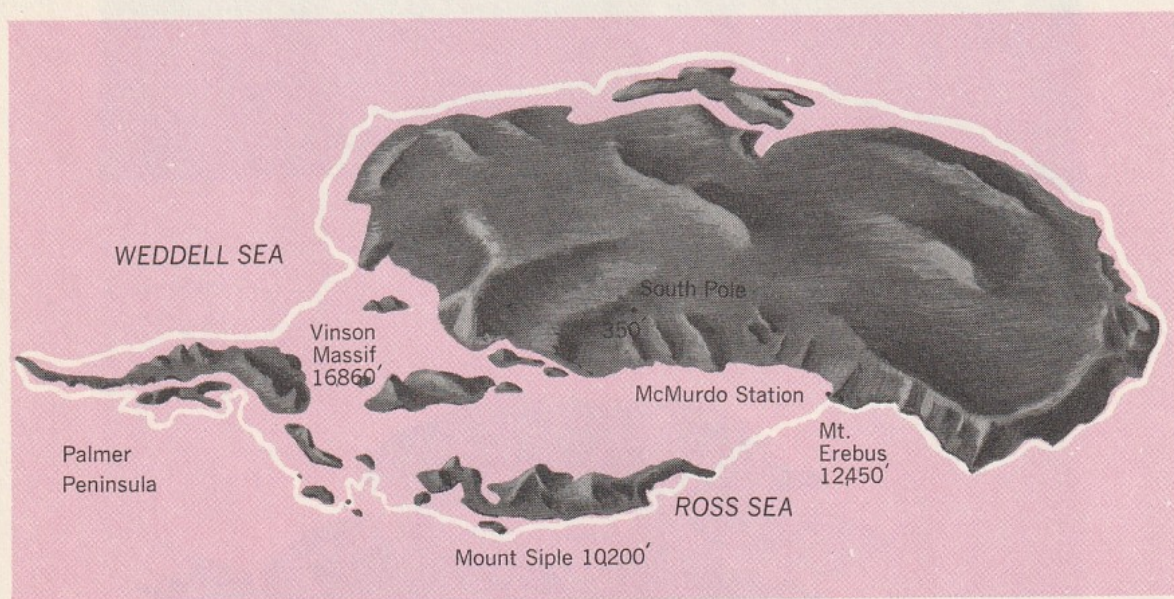
was this belief that well into the eighteenth century maps showed a sprawling Great Southern Continent, "Terra Australis".

If we accept as true what has been handed down to us in Polynesian legends, then these people were the first to sight Antarctic ice. According to Rarotongan legends, around the year 650, Ui-te-Rangiora and other Polynesians sailed in a canoe called Te-Tvi-o-Atea as far south as the frozen sea. It was around the beginning of the fifteenth century that some maps began showing an "Ant-arctica" that extended south from just below the Equator and included a vast land mass occupying parts of the Pacific, Atlantic and Indian oceans.

Belief that the great continent could include southern Africa was upset when Vasco da Gama rounded the Cape of Good Hope in 1497, but the southern tip of the newly-discovered America had yet to be defined. Thus the scene was set when Magellan, seeking a route around the world in 1520, sailed through the strait at the tip of South America and reported a wild mountainous land to the south, which he called Tierra del Fuego. European geographers believed that here at last was the northern tip of the elusive continent.

By the middle of the sixteenth century the Great Southern Continent myth was firmly established on maps. So began the long process of lopping off sections of this supposed continent until it was cut down to its proper

Antarctica Stripped of Its Ice

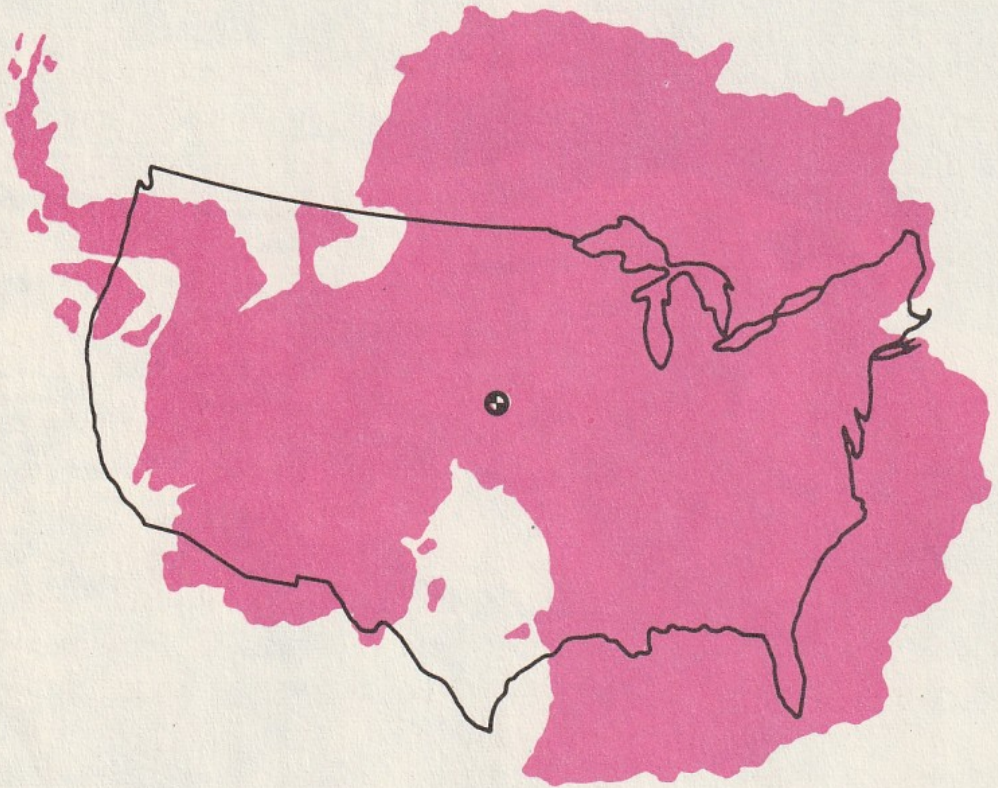




size. Sixty years after Magellan, Sir Francis Drake discovered that Tierra del Fuego was not a vast continent, but that immediately south of it was the stormy rendezvous of the Atlantic and Pacific oceans. Drake predicted that Cape Horn was the "uttermost part of the land towards the South Pole". But around the same time the Solomon Islands were discovered in the Pacific and declared to be the fringes of the mysterious Southern Continent. And so it went until Captain James Cook finally solved the mystery in the late eighteenth century.

One hundred years after Drake, an English merchant named Anthony de la Roche was swept off course while trying to round Cape Horn and accidentally found shelter in a snow-covered mountain-ringed bay. De la Roche mistook it for the Southern Continent and once again the idea blossomed. It was actually South Georgia, now populated the year round and called "the gateway to the Antarctic".

RELATIVE SIZE OF ANTARCTICA AND AMERICA



In 1642, Abel Tasman proved that Australia could not be part of the Southern Continent when he sailed beyond its southern limit to New Zealand. Dutch sailors were finding nothing but an empty Indian Ocean as they cruised farther and farther south on their way to the East Indies. Through accident rather than design, man was clearing the maps and approaching nearer to the true geography of Antarctica.

In 1738, France decided to seek out this mythical Southern Continent to make up for her losses in the New World. Bouvet de Lozier headed an expedition that skirted icefields for a thousand miles but failed to find any land. On his return, however, he correctly reasoned that such large amounts of ice could come only from a great land mass. He declared that the open sea does not freeze, even near the pole; therefore great fields of ice must come from great land. Encouraged by this report, France sent another expedition in 1771, under the leadership of Yves Joseph de Kerguelen-Trémarec. This young, impressionable Frenchman swiftly found land at a southern latitude similar to the northern latitude

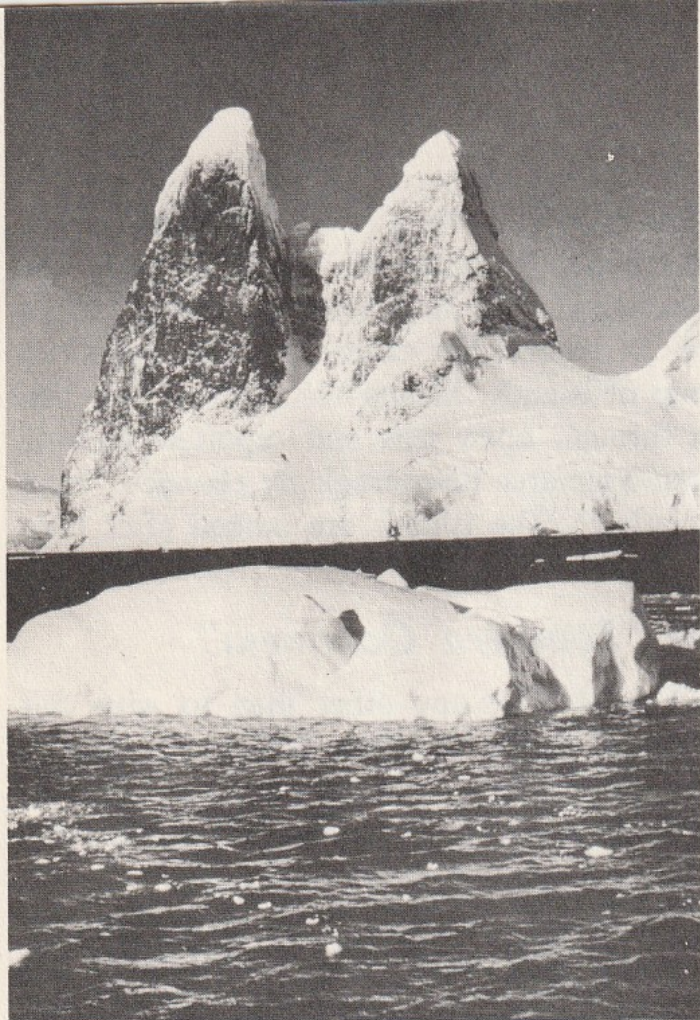
of Paris. Elated, he returned immediately with a vivid description of a "New France" rich in "woods, minerals, diamonds" that formed "the central mass of the Antarctic continent". The next year he returned for a better look and was dismayed to realize his discovery was merely a barren, cold and fog-bound group of islands. Meanwhile James Cook had already sailed far to the south through open seas and reported sighting no continental land. So Kerguelen-Trémarec discouragingly changed "New France" to "The Land of Desolation". The islands are named after him.

The End of the "Southern Continent"

IT WAS JAMES COOK who did more than any other man to wipe out forever the myth of an immense fertile Southern Continent. During the course of two great Pacific and Antarctic voyages, he not only removed the sprawling imaginary continent from the maps, but warned the world that it was a waste of time to go where he had been.

Cook was the first of the great modern scientific explorers, a master navigator who kept accurate and detailed charts. Great Britain at the time was anxious not to be outdone by Europe's search for new colonial territories, so she commissioned Cook on an expedition to the South Pacific in 1769. The primary object was to observe the June transit of the planet Venus from a point in Tahiti, to help determine more ac-





The western end of French Passage at Palmer Peninsula, which thrusts almost 1,000 miles north-west toward South America.

curately the distance of the earth from the sun. But Cook also had secret instructions to search for the Southern Continent.

In his first voyage he crossed the bottom of the world from Cape Horn in South America to Tahiti. He circumnavigated and charted New Zealand, proving that it could not be part of the great Southern Continent. On his second voyage in 1772–74, he sailed south from Africa and became the first European to cross the Antarctic Circle. He got to within about 100 miles of the continent, the most southerly point reached in the eighteenth century. But when he found no trace of land, and was hopelessly blocked and harassed by the pack ice, he declared himself “well satisfied no continent was to be found in this ocean but must lie so far south as to be wholly inaccessible on account of ice.” Thus the Great Southern Continent myth was apparently finally exploded.

During his voyages, Cook unluckily missed sighting the Antarctic peninsula—Palmer Peninsula—off South America. But he did rediscover South Georgia, the first typical Antarctic land. When he returned home, Cook described the islands he had seen as “condemned to everlasting

frigidity by nature, never to yield to the warmth of the sun." He said that even if anyone did discover a continent in the Antarctic, "the world will derive no benefit from it." Thus Cook, a great explorer, discouraged enthusiasm for Antarctic exploration for the next fifty years.

Fishermen, however, were interested in his reports of great numbers of seals and whales in the deep southern waters. Seal hunters from Europe and North America soon swarmed into the ice-filled seas of the south, gambling for wealth. Slaughter of the seals became a massacre and the sealers ranged far and wide in their search for new hunting grounds. They might have been the first to sight the true mainland of the continent, but they usually kept their records secret to guard against competition.

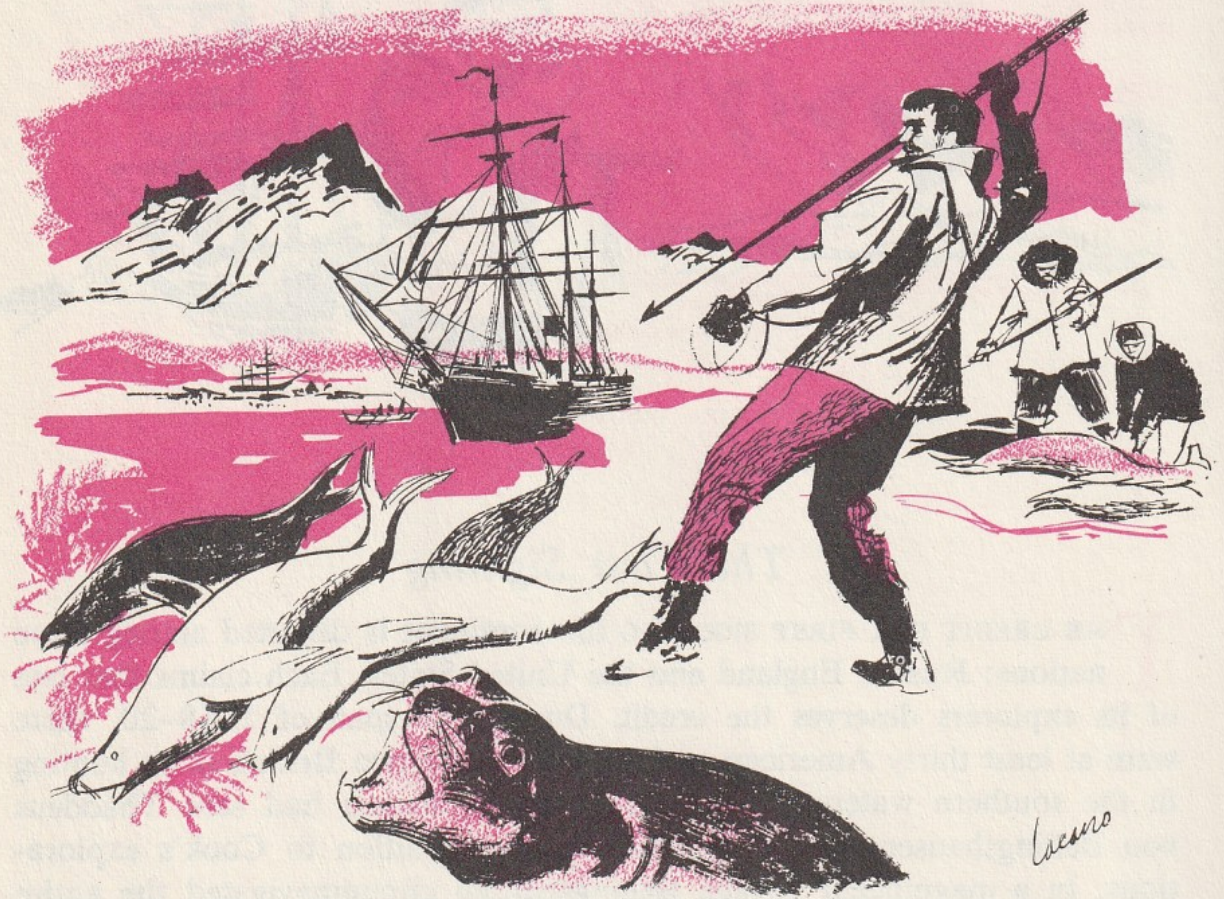


The First Sighting

THE CREDIT FOR FIRST SIGHTING the continent is disputed among three nations: Russia, England and the United States. Each claims that one of its explorers deserves the credit. During the span of 1818–20, there were at least thirty American sealers and twenty-two British ships hunting in the southern waters. In the same period, Russia had sent Thaddeus von Bellingshausen on the first follow-up expedition to Cook's explorations. In a magnificent voyage Bellingshausen circumnavigated the entire continent, always within sight of the threatening pack ice.

The British base their right to the credit for first sighting the continent on the records of William Smith, who in 1819 discovered the South Shetland Islands. Smith later sailed from these islands and wrote of seeing the peninsula now called Graham Land.

The Americans have put forth as their contender a twenty-one-year-old sealer from Stonington, Connecticut, named Nathaniel Palmer. As a matter of fact, this peninsula appears on American maps as Palmer Peninsula, not Graham Land. As part of a large fishing fleet, Palmer was sailing in a small ship, hardly bigger than a yacht. After sighting the peninsula he was on his way back to rejoin the others when he found himself closed in by a thick fog. Suddenly from out of nowhere appeared the two large ships commanded by Bellingshausen, who was at the tail end of his long circumnavigation. Bellingshausen was astounded to see so small a ship in waters that he thought he was the first to penetrate. Even



Seals were slaughtered for their valuable fur by nineteenth-century fishermen.

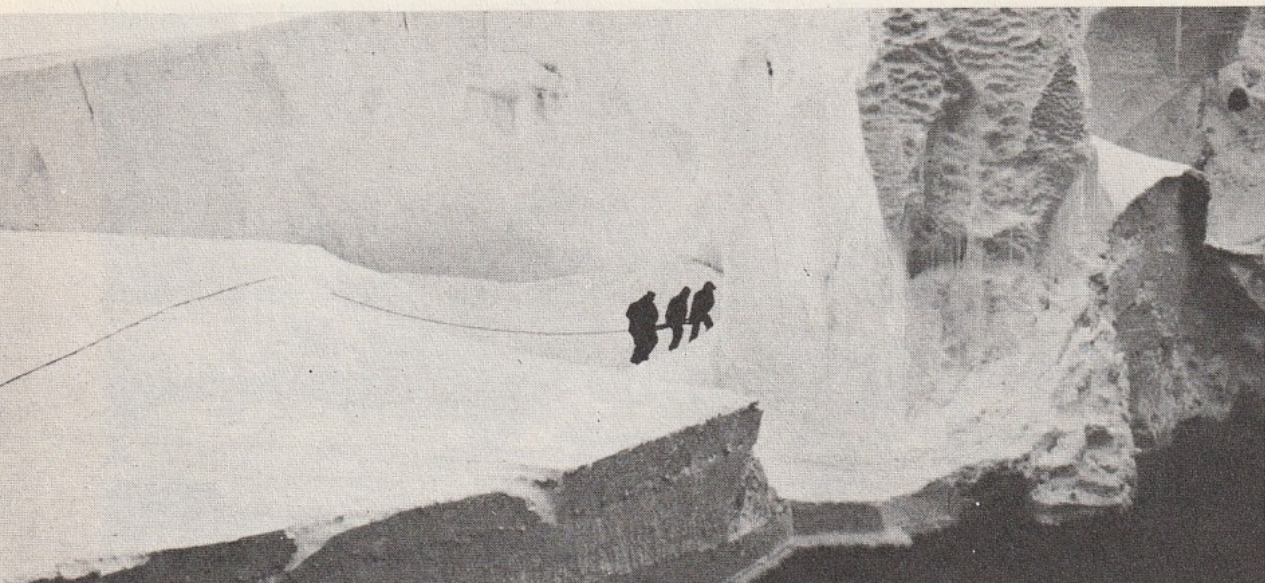


A bull elephant seal is about to swivel around and attack the man walking between him and his small herd of cow elephant seals.

so, the Russians firmly maintained that Bellingshausen was the first to sight the true continent. The question of who really did first sight the continent probably will never be settled.

By the second quarter of the nineteenth century, sighting of the continent was becoming a common thing. Sealers were flocking to the area around the peninsula. An enlightened British sealing and whaling firm called Enderby Brothers was sponsoring many commercial ventures, and it encouraged the pursuit of discovery as well as sealing profits. One of their ships, captained by James Weddell, in 1823 sailed deeply into the waters forming an enormous dent on the east side of Graham Land Palmer Peninsula, thereby discovering the Weddell Sea. Eight years later John Briscoe discovered the coast of that part of Antarctica nearest South Africa and named it after his employers, Enderby Land.

Eventually, when sealing profits fell off as the hunting grounds became overworked, interest in Antarctica slackened. A new stimulus was needed, and the growing consciousness of science provided it. This new awakening interest was in terrestrial magnetism—the search for the south mag-



netic pole. Eventually it was to lead to the greatest land exploration effort ever undertaken by man.

Explorers of the Continent

COOK HAD DEFINED the Antarctic region. Whalers and sealers had located a few points of its pear-shaped outline. Next it was to be probed, explored and opened for present-day scientific exploration. Up to the time of the whalers, no one knew whether the Antarctic was a continuous land mass or, perhaps, a group of ice-covered islands with channels between them. Many small expeditions set out, eager to learn all they could about this exciting new continent, and more than casually interested in claiming slices of the territory for their country. All were prepared to carry on some kind of geographical and scientific research. At first this was concerned mostly with the mystery of terrestrial magnetism.

As world trade increased on the seas, the importance of precise navigation became more and more important. Scientists realized that navigation could be greatly improved if they knew more about the earth's magnetic forces. The north magnetic pole had already been located by James C. Ross in 1831, and geographers knew that the earth, acting as if it were a huge

magnet, must also have a south magnetic pole. In taking magnetic measurements with a dip-needle compass, only at the Equator is the needle horizontal. The nearer the magnetic pole, the greater will the needle dip, until at the magnetic pole itself the needle is vertical. To discover the exact position of the south magnetic pole three nations—France, England and the United States—all prepared expeditions around the same time.

The French, under the leadership of Dumont d'Urville, were the first to reach the general vicinity of the south magnetic pole. In 1840, thinking



4.

DESERTED ANTARCTIC WHALING STATION

This deserted whaling station on Deception Isle in the South Shetland Islands, off the west coast of Palmer Peninsula, was a hive of activity back in the nineteenth century. Today the factory ship has replaced the whaling station.



that they could sail over it, they got to within four degrees of vertical before they realized that the pole was inland, somewhere out of reach behind the ice-covered coast. D'Urville named the area Adélie Land, in tribute to his wife.

Nine days after the French had left, the Americans, under Captain Charles Wilkes of the U. S. Navy, reached the same position on the coast. Wilkes accurately determined that the mountainous coastline belonged to a continental land mass and not a group of islands. He hoped to sail along this coast to Enderby Land, 2,500 miles to the west, discovered nine years earlier by Briscoe, but the pack ice made it impossible. Both the French and the American expeditions were very poorly equipped, and were unprepared for the rigors of Antarctic exploration. The men were ill-clad and frequently weakened by scurvy. The ships' rigging continually froze and the sails were taut with ice. They barely survived through the stormy iceberg-cluttered seas.

The British expedition enjoyed all the advantages the French and Americans lacked. Their leader, James C. Ross, was a man with long polar experience. He had served several seasons in the Arctic and, most important, his two ships, *Erebus* and *Terror*, were reinforced to help them batter their way through the pack ice. When Ross learned that the other two countries had beaten him to the area, he was annoyed and decided to sail a little farther to the east—a stroke of luck, as he later realized. This had always been an unpenetrable area because of heavy pack ice. After four days in the ice, carefully snaking through leads opened by the pressure of the bows, Ross was astonished to come into clear open water again—the sea which bears his name today. He named the coast of this area Victoria Land and discovered an active volcano—12,450 feet high—which he named Mt. Erebus. Its sister peak he called Mt. Terror.

For the next sixty years, however, exploration of the Arctic, not the Antarctic, held the focus of world attention. The desolate southern continent seemed to promise little of any immediate “value”. But during this period a few farsighted men stubbornly pressed for continued exploration of the Antarctic. One of them was Captain Matthew Maury, of the U. S. Navy, a pioneer in the science of oceanography. Time and again he called for international co-operation to explore inland Antarctica, which he described as being “as little known as the interior of the Moon”. Other scientists, such as Alexander von Humboldt (whose magnetic theories had stimulated Ross's voyage), and the mathematician Karl Friedrich Gauss, were also calling for international efforts. In the late

1800s Dr. Georg von Neumayer, who had continued these studies in magnetism, meteorology and navigation, was also pressing for the renewal of scientific exploration of Antarctica.

But once again it was the whalers, not men of the academic world, who led the way. The invention of the harpoon gun meant that it was no longer necessary to chase the whales in small, open boats; faster, longer and safer boats could be used. The Norwegians soon sent a reconnaissance expedition into the Ross Sea in search of "right" whales mistakenly reported by Ross. Although they failed to find any, their reports of the area helped renew an interest in scientific exploration.

Wintering in Antarctica

THE BELGIANS ORGANIZED an international scientific expedition that reached the Antarctic in 1897, led by Adrien de Gerlache. Serving





as first mate on their vessel, an old sealer named the *Belgica*, was the Norwegian Roald Amundsen (who was later to be the first man to reach the South Pole). Because the ship spent part of the precious summer cruising off Palmer Peninsula, by the time she headed south into the pack, winter was just beginning. Within only a few days, ice locked and cemented around the ship, and for the next thirteen months the *Belgica* was held prisoner, drifting with the pack about the Bellingshausen Sea. It was the first time men had ever spent a winter within the Antarctic Circle, and the crew was physically and mentally unprepared for such an experience.

Plagued by intense cold, blizzards and living in a tiny enclosed community, the men exaggerated every incident and their nerves became raw. The same joke told twice was enough to touch off a bitter argument. Because of the men's distaste for fresh seal and penguin meat, the doctor's orders were sometimes disobeyed and signs of scurvy were ever present. During seventy-one days of continual, total, depressing darkness, some of the men nearly went mad. Each "night" one of the crew members slept in a protective corner because he thought that his shipmates were

plotting to kill him. It was a long winter nightmare. But with the return of the sun and the coming of spring and the promise of summer the crew's mental health began to improve. The scientific nature of the expedition was abandoned; all energy was now concentrated on freeing the *Belgica* from the death grip of the ice pack. When explosives failed, they resorted to hand saws, cutting a channel through the seven-foot-thick ice to the open sea. But it wasn't until March, more than a year after she first became locked in the ice, that the *Belgica* was able to sail back towards civilization.

In 1898 Carsten Borchgrevink, one of the men from an earlier Norwegian whaling reconnaissance, organized a British group that sailed from Australia and became the first scientific party to set out with the intention of wintering on the mainland. Borchgrevink's ship served merely to provide transport and did not remain in the hazardous seas during the eleven-month interval the men were camped on land. From his base at Cape Adare, Victoria Land, Borchgrevink was the first to sledge over



Captain Robert Falcon Scott of the British Royal Navy led the very successful National Antarctic Expedition of 1900–1904 in this ship, the *Discovery*. It was later moored on the River Thames at London.

5. CAPTAIN SCOTT'S "DISCOVERY"

the surface of the Ross Ice Shelf. He proved that wintering on the continent was physically possible. Among his valuable scientific findings was an observation that the face of the Ice Shelf had retreated several miles since Ross had surveyed it nearly sixty years earlier. (The Americans were to make a similar discovery as the IGY got under way.)

Expeditions of the 1900s

BY THE TIME BORCHGREVINK returned, more scientific expeditions were being prepared in Great Britain, Germany, Sweden and France. The Antarctic was no longer to be ignored. The new discoveries and accomplishments were many during these early years of the 1900s.

The Germans, led by Erich von Drygalski, became the second group to be locked in the winter pack ice. But sheer ingenuity saved them. They spread ashes to form a path from their ship to open water. The ashes absorbed enough heat from the sun to melt the ice and form a six-foot-deep channel of escape! And in contrast to the *Belgica*, the group carried out many important scientific observations, discovered and named Mt. Gauss, and later discovered a land area which they named after Kaiser Wilhelm II. The Swedes, guided by Otto Nordenskjöld, spent two winters ashore on Palmer Peninsula. They proved that it was possible to live off the land (provided there were enough penguins and seals for food and skins), and collected many fossils. Naturalist William S. Bruce directed the Scottish party which discovered and explored Coats Land on the Weddell Sea. Bruce set up a meteorological station on Laurie Island in the South Orkneys, but when he failed to obtain financial support to maintain it, he turned the camp over to a group from Argentina. This provided a foothold for Argentine sovereignty and a political hassle that has yet to be resolved.

Of all the expeditions around this time, it was the British who created the greatest impact. Led by Robert Falcon Scott, they made the first deep inland push to the heart of the continent.

In the ship *Discovery*, Scott sailed into the Ross Sea and selected an inlet called McMurdo Sound as the site for his base, near the edge of the Ross Ice Shelf. In November of 1902, Scott started off with dog teams in an effort to get as far south over the ice shelf as he could. He was accompanied by Ernest Shackleton and Dr. Edward Wilson. They trekked through freezing winds and blizzards across the great ice shelf, and after seven weeks were within about 500 miles of the South Pole. But the



One corner of *Discovery Hut* as it looks today. It adjoins the U.S. headquarters at McMurdo Sound, and is now overshadowed by huge red gasoline storage tanks.

hardships were mounting and their energy was beginning to falter. Since they had brought too little food with them, hunger was their chief enemy. In addition, Dr. Wilson was suffering from snow blindness. Worst of all the dogs had not measured up to expectation and were dying from a form of animal scurvy. The men themselves were weakened from scurvy—Shackleton especially—and they soon realized that they would have to turn back. Their farthest position south was latitude $82\frac{1}{4}^{\circ}$ S. On their way back they had to kill their remaining two dogs, useless now, and pull their own sledges. Exhausted and ill, the three men returned to the ship—having covered a distance of 960 miles in ninety-three days. It was a magnificent effort.

Shackleton, because of his weak condition, was sent home on the relief ship *Morning*. After spending a second winter at McMurdo Sound, Scott led another party inland up the Ferrar Glacier to the great, featureless plateau larger than Europe. During their return they discovered an ice-free valley and at the end of it a lake three to four miles long.

Science Bulletin

Prepared by SCIENCE SERVICE

NEW ICE AGE COMING?

Immense glaciers of a new Ice Age may start creeping across the land in a few thousand years, with a peak about 15,000 years from now, according to new studies of ocean cores.

We are approaching another glacial period similar to those which have advanced over the earth eight times in the past 425,000 years, according to Dr. Cesare Emiliani of the Institute of Marine Science, Miami, Florida.

As a result of recent investigation of ocean and land cores, it appears almost certain that the traditional theory of four or five major glaciations will have to be abandoned—and many textbooks may have to be changed.

In its place is apparently emerging a picture of many alternating high and low temperature states, fluctuating in waves of as much as 18 degrees Fahrenheit over an average period of 50,000 years. These stages will continue for millions of years in the future until the mountains are eroded away and the seas have moved onto the land, thus diminishing the cloud cover that reflects back the sun's radiation. Then the earth will warm up and the glacial periods will be ended.

Temperature oscillations during the past million years have been studied by means of isotopic, chemical and micropaleontological analysis of fossil remains in deep sea cores from the Caribbean Sea and the equatorial Atlantic Ocean, reported Dr. Emiliani. The average temperature of the earth's surface may have decreased 9 to 18 degrees Fahrenheit during the past 150 million years. This decrease may be due in part to a decrease in solar emission as the sun—that great "nuclear machine"—used up a fraction of its probable life.

ANTARCTICA AND MARS

A team of biologists have been gathering samples of the frigid, desert-type soil of Antarctica, searching for microorganisms. The Antarctic studies will provide information that is needed in the design of life-detection experiments to be sent to Mars.

Because of its thin atmosphere and lack of water, Mars is believed to be largely desert. Biologists have previously found lichens and mosses at sea level in Antarctica, but studies in the higher valleys were "sketchy", according to the University of California's Jet Propulsion Laboratory, and yielded no microorganisms. The Jet Propulsion Laboratory conducted the research under sponsorship of the National Aeronautics and Space Administration of the U.S.

RADAR PROBES ANTARCTIC ICE

A new radio sounding device has been used to record the depths of ice and the profile of rock surface beneath the ice for 830 miles across the lonely Antarctic plateau.

The new instrument was mounted on one of three large tracked vehicles that recently arrived at one of the U.S. stations. One Norwegian and nine U.S. scientists, with their Belgian leader, completed the second stage of a

projected 5,000-mile four-year expedition from the South Pole to a point near the coast of Queen Maud Land. The first stage, completed in 1965, extended from the South Pole to the Pole of Inaccessibility.

The radar instrument, which had been tried out briefly in 1965, automatically took soundings to the ice depth and rock surface. These were recorded on tape. Formerly, scientists could determine the ice cap depth only on a "spot" basis by means of slow and cumbersome methods of seismic explosions and gravity profiles.

Scientists of many nations are engaged at Antarctica in continuous study of the depth of the ice cap and the nature of the land beneath, as well as with the region's weather and the earth's magnetic field. Research projects of the United States are conducted under the U. S. Antarctic Research Program (USARP), part of the National Science Foundation and the U. S. Navy.

MELTED ICE FLOODED ANCIENT ANTARCTICA

A raging river of melted glacier ice flooded a valley in Antarctica several centuries ago, cutting deep, winding channels in bedrock.

For years scientists have puzzled over this strange eroded terrain that covers about seven square miles at the head of Wright Valley, west of Ross Island. Some thought the rock was carved by ordinary melted glacier water that had been dammed by a tongue of glacier ice to form a lake and then suddenly poured down the valley when the ice dam gave way.

What really must have happened, reports Dr. Charles R. Warren of the U. S. Geological Survey, was that a volcano under the thick glacier ice erupted, creating a great flood that may have carried more water than any river ever seen by man.

The actual volcano has not been probed, but it is deep under the ice where other volcanoes are also located.

Evidence of the volcanic flood is the low content of heavy water in Lake Vanda, located in the deepest part

of Wright Valley. This permanently frozen lake, more than five miles long and one-and-a-half miles wide, has less deuterium in the salty water at the bottom than most glaciers and melt-water.

Dr. Warren calculated that this could happen only if that part of the water entered the lake from the west, from the volcanic eruption. The only water entering the lake today comes from the east.

The mixture of teeming volcanoes and ice has also occurred in other parts of the world, Dr. Warren noted.

NEW ANTARCTIC STATION

New Zealand is to open a year-round scientific station in Antarctica similar to, but smaller than its Scott Base station. The station will be in the Dry Valley region of McMurdo Sound about fifty miles from Scott Base. The area is free of ice and snow in summer. Little is known about the area in winter.

In summer scientists of many nationalities examine the geology and physics of the area. Physicists are interested in the excessive salt content of the lakes and the abnormally warm areas below their ice cover where 77 degree temperatures have been noted. The only life in the valleys is microscopic, collecting around the shores of the lakes and streams from the snouts of glaciers. Since New Zealand's Antarctic research started ten years ago, parties from Victoria University of Wellington have worked in the valleys during the summers.

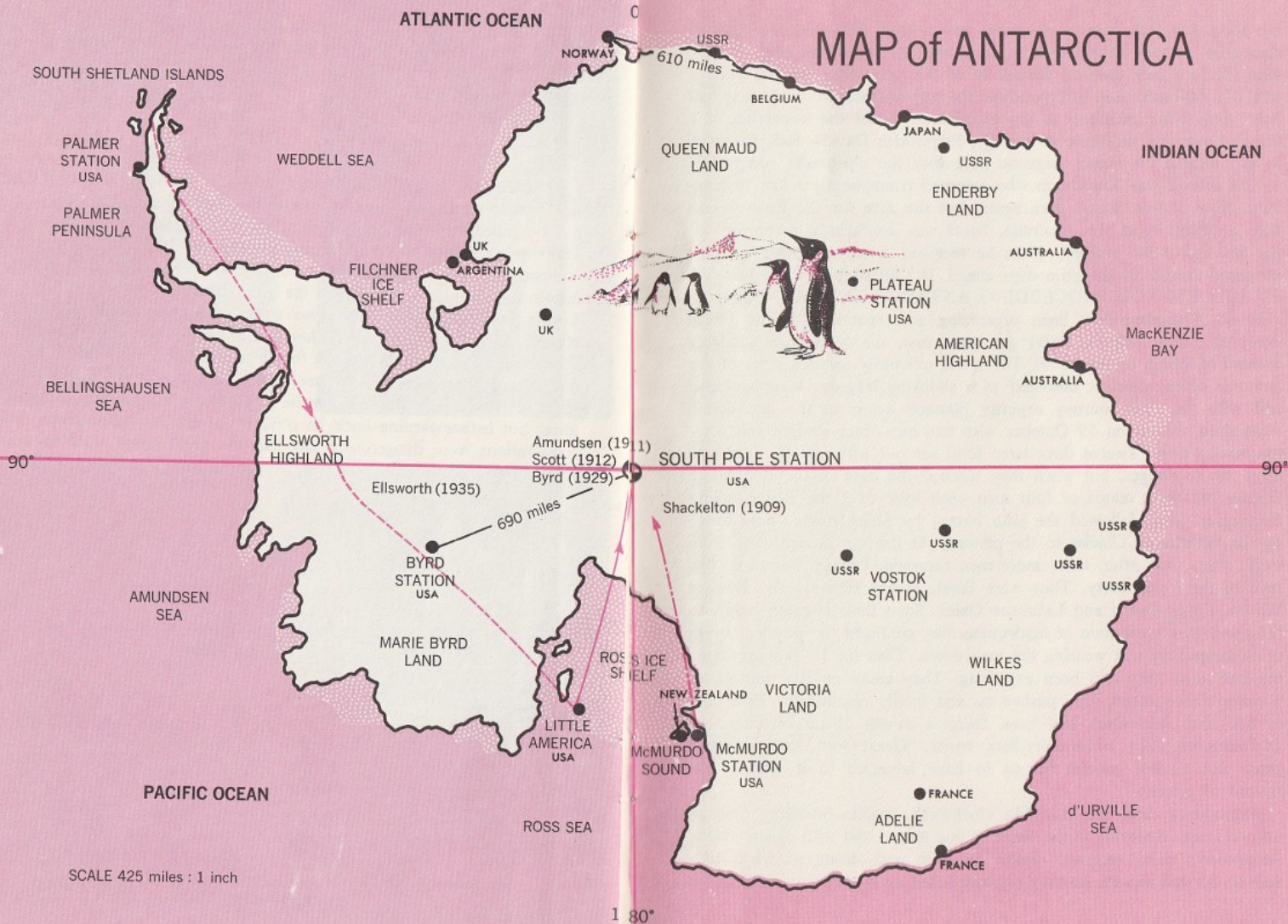
Scott returned triumphantly home with a mass of scientific data. His accounts of long sledge journeys and the discoveries waiting to be made provided excitement and drama. The effect was to trigger off a race to reach the South Pole.

The Race to the South Pole

SHACKLETON, FULLY RECOVERED from his previous illness, was the first to announce an expedition to the Pole. Feeling that dogs could not be relied upon to perform well on ice, Shackleton decided to try Manchurian ponies to do the heavy pulling. In 1908 Shackleton, three companions, and the four ponies that survived the voyage set off from McMurdo Sound. He discovered the great Beardmore Glacier, and after working their way up it for two weeks the party reached the great plateau. By this time, however, they had killed three of the ponies to eat on the return journey. When the fourth plunged into a crevasse the men had to pull the sledges themselves. When Shackleton got to within 130 miles of the Pole, he realized that he could not attain his goal and return alive; but before turning back he pushed on eighteen miles more. Their food rations were dangerously low and the great height (10,000 feet), the cold and blizzards had sapped their strength. They turned back none



MAP of ANTARCTICA



too soon, for then came a desperate seven-week, 800-mile race against starvation as they struggled from each food depot to the next. By the time the four men reached the safety of the base, they had travelled a total of 1,600 miles and had pioneered the way to the Pole. While they had been gone, other members of the expedition—under the leadership of a fifty-one-year-old professor of geology, Edgeworth David—had journeyed to and located the south magnetic pole with the dip-needle compass.

This time it was Shackleton who returned triumphantly home to England. Now, it was Scott's turn again, but the race for the Pole was to take a fateful twist. In Australia, Scott was confidently preparing for the last leg of his journey, when he received a telegram message that promised drama for the grim days ahead. It read simply: **BEG LEAVE TO INFORM YOU PROCEEDING ANTARCTICA. AMUNDSEN.**

Roald Amundsen had been organizing an expedition to the North Pole, but when Admiral Peary got there first, the Norwegian suddenly decided to switch to the South. The world anxiously awaited news of the outcome of the race. It unfolded as a shocking tragedy. Well equipped and with the hard journey expertly planned down to the last detail, Amundsen set out on 19 October with five men, four sledges and fifty-two strong dogs. Twelve days later Scott set out with ponies, dogs and three motor sledges, but when they reached the base of the Beardmore Glacier the three teams of four men each took over the sledge-pulling themselves. Scott followed the path blazed by Shackleton's "near miss" up the Beardmore Glacier to the plateau. At the top he sent one team back; then, soon after, three more men returned, leaving a total of five men in the Polar Party. They were Scott, Henry Bowers, Dr. Edward Wilson, Edgar Evans and Laurence Oates. Soon their strength began to fail them. A combination of inadequate diet, cold and the physical strain of sledge-pulling was wearing the men down. Then on 16 January came the bad news they had been expecting. They came on the remains of a camp! Discouraged, they pushed on and finally reached the Pole only to find that Amundsen had been there a month ahead of them, on 14 December, 1911. In his diary Scott wrote: "Great God! this is an awful place and terrible enough for us to have laboured to it without the reward of priority."

Amundsen's dash had gone like clockwork, despite travelling over an untried route. Believing in the value of dog teams, and with expert skiers, Amundsen's party returned almost as fresh and strong as when they started. So well was the journey organized that he was able to write in his

In 1902 on his first expedition, Captain Scott built *Discovery Hut* at McMurdo Sound. It was used on subsequent expeditions as a storage depot and to this day cases of biscuits remain outside the hut in mute memorial to a great explorer.



diary on the way back that “we had such masses of biscuits that we could positively throw them about.” The fate of Scott and his group was grimly different.

The long pull up the glacier and across the plateau had been exhausting, and poor food, heavy winds, soft snow and cold added to the burden of sledge-hauling. In his heart Scott must have sensed the bitter days ahead. “Now for the run home and a desperate struggle,” he wrote in his diary. “I wonder if we can do it.” Even before they reached the edge of the plateau, they were in trouble; Wilson had hurt his leg, Evans’s hands were so frozen that his fingernails dropped off, and Scott had injured his shoulder. Yet they stopped from time to time to collect fossils and make other scientific observations in hopes of being able to tell the world what Antarctica was like.

On 14 February, when they had nearly descended the Beardmore Glacier, Evans died. Four weeks later Oates bravely left the tent and walked to his death in a howling blizzard, in order not to be a burden to the rest of the party. Nearly starved, totally exhausted and slowly freezing, the remaining three men pitched their tent for the last time. Although they were near a food depot, a blizzard kept them inside for days on end. All knew the end was near. One of Scott’s last entries was written in the midst of the blizzard: “Every day we have been ready to start for our depot, eleven miles away, but outside the door of the tent it remains a scene of whirling drift. We shall stick it out to the end but the end cannot be far.” Eight months later, in the spring, a search party found the



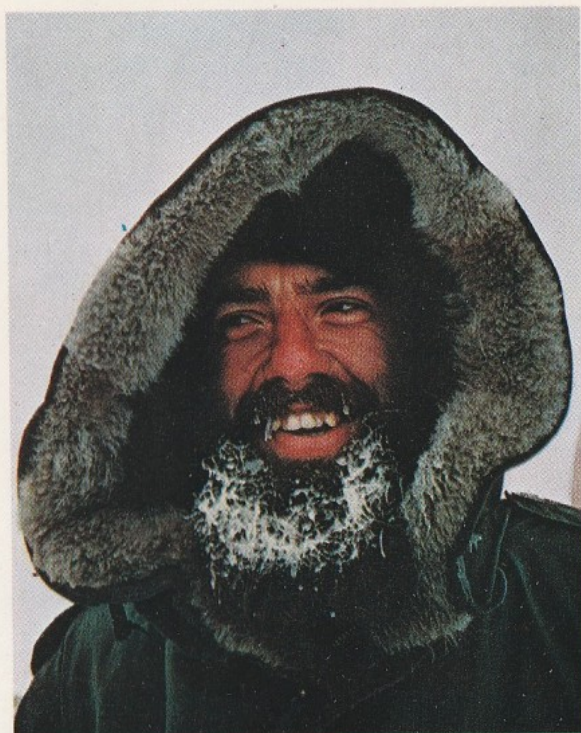
"I am just going outside, and may be some time." He went out into the blizzard, and we have not seen him since . . . it was the act of a brave man and an English gentleman.

Scott's Diary. March 16, 1912

tent, the bodies and the fossil specimens Dr. Wilson had insisted on keeping.

In 1914, Shackleton set out for Antarctica again, this time in an attempt to cross the continent by land from the Atlantic side to the Pacific—from the Weddell to the Ross Sea. But he never set foot on the mainland at all. Heavy ice pressure crushed his ship in the Weddell Sea and the party was forced to camp on the sea ice. Then began one of the most perilous sea journeys in polar history. In an effort to get help, Shackleton, with six carefully picked men, voyaged through 600 miles of gale-tossed seas in an open boat only twenty-two and a half feet long, to South Georgia. He landed on the wrong side of the island and had to scale the mountainous interior before finally reaching the whaling station, where a party was organized to rescue the remaining twenty-two men left on Elephant Island. It was another of Shackleton's heroic, glorious failures with a happy ending.

The modern Antarctic explorer is a far more fortunate individual than his famous predecessors. He is in constant radio touch with the outside world; supplies are brought regularly by plane, helicopter and Sno-cat. But in one respect conditions have not changed. Today's scientific explorer must still live in a harsh world of ice and snow where the moisture of one's breath freezes onto one's beard.



7.

MODERN EXPLORER

This photograph of Captain Scott and his ill-fated team, taken at the South Pole and showing the Norwegian flag atop a tent, was made from a roll of film recovered from under their bodies eight months later.



Douglas Mawson's Adventure

IN ADDITION TO SCOTT, AMUNDSEN AND SHACKLETON, there was a fourth dauntless figure in this early twentieth-century era who defied the treacheries of the lonely wasteland. Australia sent Douglas Mawson at the head of an expedition in 1912 that enabled Australia to claim nearly half of the continent. At Cape Denison, which Mawson described as "The Home of the Blizzard", they were battered by blizzards and winds that reached as much as 200 miles an hour. Mawson recorded the *average* wind velocity for the month of May at 60.7 miles an hour, and the following winter it blew at an average of 107 miles an hour for an eight-hour period. The reason for these strong, steady winds soon became clear: cold air high on the Polar Plateau, seeking a lower level, flowed down the steep slope of the plateau and constantly swept the area where Mawson had set up his weather station.

Mawson was the sole survivor of a bitter journey that began 10 November, 1912 to explore part of the coast. Of his two companions, one fell down a crevasse and disappeared with most of the supplies.



Sir Hubert Wilkins was the first to use an airplane in the Antarctic.



6.

EXPLORING BY SNO-CAT

The Byrd Traverse Party of the U. S. Navy Operation Deep Freeze IV consists of a train of three Sno-cats, each pulling sleds and containing a crew of two men. They are exploring an uncharted area of the Antarctic continent.

The other died from cold and food poisoning. Alone and desperate, Mawson staggered on, at one stage falling part way down a crevasse. Miraculously he managed to reach the base, having travelled 100 miles alone over some of the most severe and windlashed ice country in Antarctica. This was a tremendous feat of endurance.

By the end of World War I, much of the coast was still unexplored. As for the interior, little more than a narrow strip from the Ross Sea to the Pole had been described. Yet, during that fairly short period between the wars, the remaining coastline was explored and mapped, and



8.

LOADING SUPPLIES INTO A GLOBEMASTER

Huge containers of gasoline are hoisted into the belly of a giant U. S. Globemaster. In all, a total of fifteen tons were delivered to Byrd Station and dropped there by parachute as part of a regular delivery service.

many new treks to the interior were made. So much work done in such a brief time was made possible by the new air age.

The first Antarctic use of the airplane was made by Sir Hubert Wilkins. Between 1929 and 1930 he made several flights over Palmer Peninsula, proving that air exploration was practical. Seven years later, an American pilot named Lincoln Ellsworth succeeded in crossing a corner of the continent in a twin-engine plane. Accompanied by a Canadian, H. Hollick-Kenyon, Ellsworth landed five times on the way across. He had taken off from Dundee Island at the tip of Palmer Peninsula and flown 2,100

miles, just short of Little America. Along the way he discovered the vast area called Ellsworth Highlands.

New Attack on the Continent

THE MAN WHO BROUGHT MODERN AIR POWER and research techniques to the Antarctic in a big way was Admiral Richard E. Byrd. He was to dominate the scene for thirty years, leading five giant U.S. expeditions. It was Byrd, and others inspired by him, who laid the foundations for today's international community of scientists who make Antarctica their temporary home in an effort to learn more about the earth, its oceans and atmosphere.

In 1928 Byrd led a forty-two-man expedition to the Antarctic. With two ships, three aircraft and 665 tons of supplies, based at the Bay of Whales on the Ross Ice Shelf, it was a larger party than had ever before wintered in the Antarctic. The base soon became known as Little America. Byrd was the first to use radio communications between dog teams and planes and in 1929 he became the first man to fly over the South Pole.

Four years later Byrd returned with more ships, more planes and more men. He also brought an experimental autogyro and snowmobile. Although the snowmobile was a total failure, it pioneered the way for later

An aerial view of Little America, partly uncovered by summer thaw, at the Ross Ice Shelf near the edge of the barrier.



effective snow tractors, and the autogyro evolved into today's helicopter. One purpose of Byrd's second expedition was to set up a base deep in the interior to record the weather during the long winter darkness. Because of insufficient supplies for more than one man, Byrd decided to man the advance station alone. It was a courageous move, perhaps even a bit reckless. After the first six weeks of isolation his gasoline generator went wrong and he suffered from carbon monoxide poisoning and nearly died. But he refused to reveal the seriousness of his condition in his radio messages. Byrd remained for five months alone, the farthest south any-



Admiral Byrd wrapping in Old Glory a stone from the grave of his beloved friend, Floyd Bennett, before dropping it over the South Pole.

one had ever wintered. Finally a rescue team reached him and nursed him back to health. Hollow-cheeked, weak and haggard, Byrd had survived a terrible ordeal.

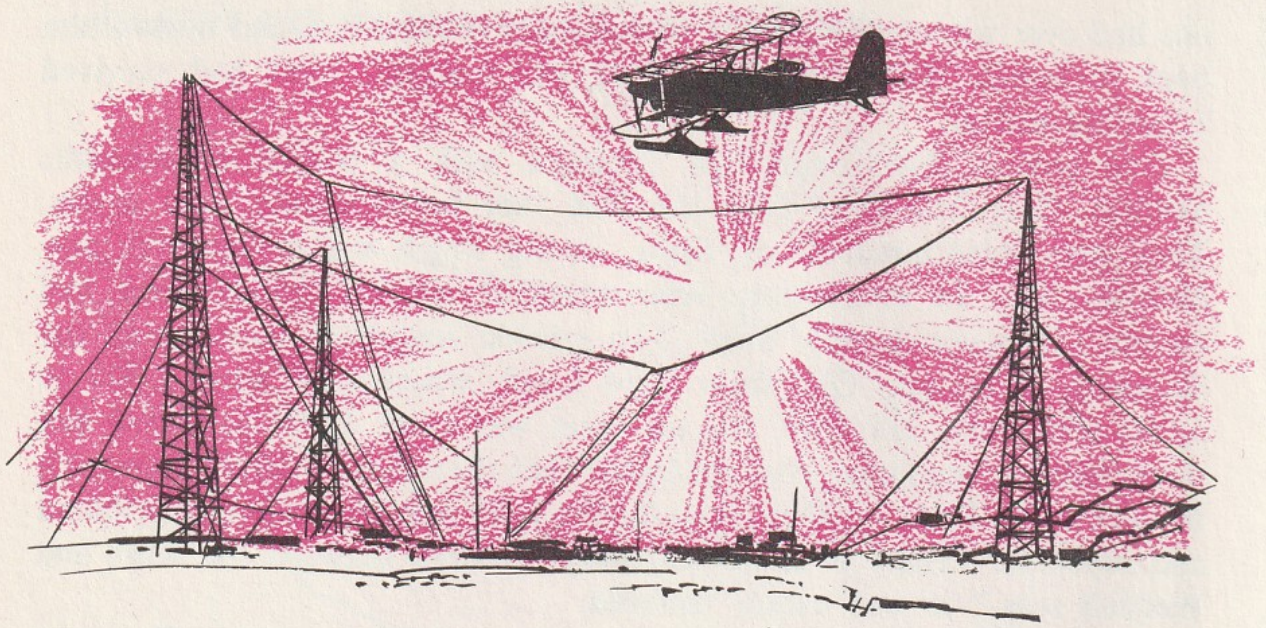
This second Byrd expedition returned with a wealth of scientific findings. Only 210 miles from the Pole they found several coal seams. They also found hundreds of fossils, among which was evidence of prehistoric trees. In addition to their constant weather observations and cosmic ray research they made 510 seismic soundings to discover the thickness of the ice. On Marie Byrd Land, where they were 2,000 to 3,000 feet above sea level, the ice sheet was from 1,000 to 2,000 feet thick. Seismic soundings also confirmed that there is an island (Roosevelt Island) in the Ross Ice Shelf. And finally, Byrd himself made flights inland and reported: "There is almost certainly no strait between the Ross and Weddell seas," as was earlier believed.

World War II began casting a shadow when, in 1939, President Roosevelt founded the United States Antarctic Service and placed Byrd in command. Other countries had already staked out territorial claims dividing the continent like a sliced-up pie. But the United States' position, still in effect today, was to ignore earlier claims of sovereignty; only permanent settlement should determine national jurisdiction. The American government refused to recognize any claims and reserved the right to make its own settlement claims in the future—particularly in the region between 78° W. and 148° W. where Ellsworth and Byrd had been.

Eager to make such claims based on settlement, the government authorized Byrd to set off once again, in 1939–41. He was to re-establish Little America. Five separate groups gathered mountains of information—geological, biological, surveying and seismological research. Overland sledge expeditions—longer than any made before—explored Marie Byrd Land and the Ellsworth Highlands. With "West Base" established at Little America, Byrd next set up "East Base" on Stonington Island, 1,700 miles from Little America. These two bases marked each end of the region to be explored by the expedition. The original plan was to establish some sort of permanent settlement on the continent, but this idea had to be abandoned in 1941 when all American resources went into the war.

Postwar Operations

AFTER THE WAR, THE UNITED STATES found itself with thousands of specialized vehicles and ships on hand—powerful icebreakers,



long-range aircraft, tanks and amphibious vehicles. The idea was proposed to put some of this surplus material to use in a giant exploratory operation in Antarctica. Such an expedition would also provide the armed forces with a training ground for polar conditions. Thus was born Operation Highjump, a massive and hastily-formed Antarctic expedition made up of 4,700 men, thirteen ships, including an aircraft carrier and a submarine, and twenty-three aircraft. This mighty armada was the biggest polar expedition of all time. In addition to its military, scientific and exploratory aims, there was also a political objective. Under Byrd's leadership, the expedition was "to consolidate and extend United States sovereignty over the largest practicable area of the Antarctic continent."

The tremendous force was split into three divisions. A Central Group, with an icebreaker leading the way through the pack ice, was to re-establish Little America. East and West Groups were to sail around the continent, each on a seaplane tender. The pack ice was especially thick that year, more than 600 miles wide. It was only with the help of the icebreaker that the main group got safely through to the continent in January, 1947. The thin-skinned submarine had to turn back, however. On arrival, Byrd set up the continent's first air base at Little America. It was for aerial and photo-exploration on the largest scale ever. Although the expedition stayed only during the brief summer season of 1946-47,

they made more than sixty reconnaissance flights that produced more than 70,000 photographs.

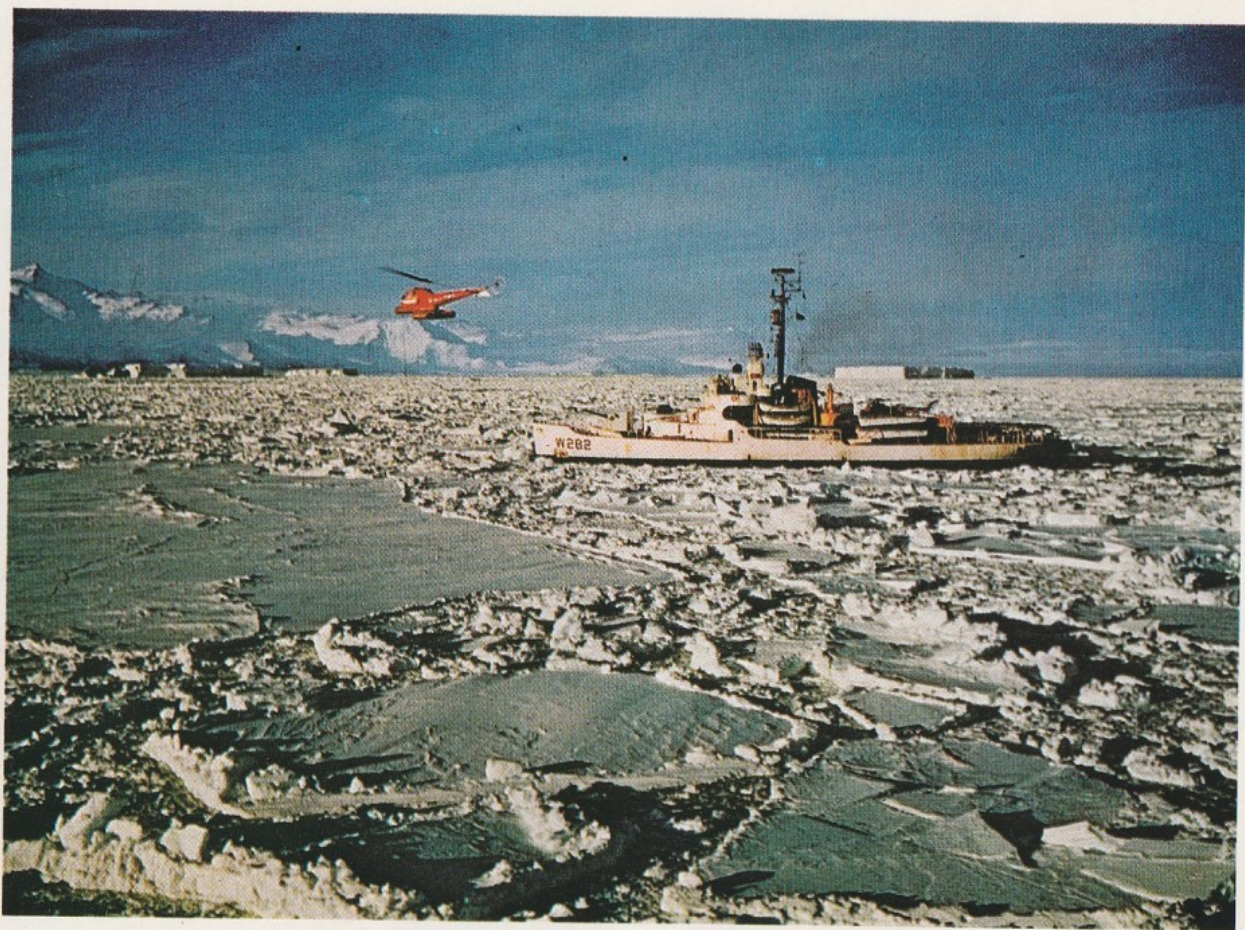
Even though the aircraft could not fly high enough (about 10,000 feet) to take photographs suitable for map making, the photographs nevertheless showed terrain never before seen by man. And the photographs of the coasts were good enough to show that roughly forty per cent of the coasts surveyed by air had been charted inaccurately by earlier expeditions.

The following summer season the United States sent out a new expedition to follow up the photographic survey of Operation Highjump.



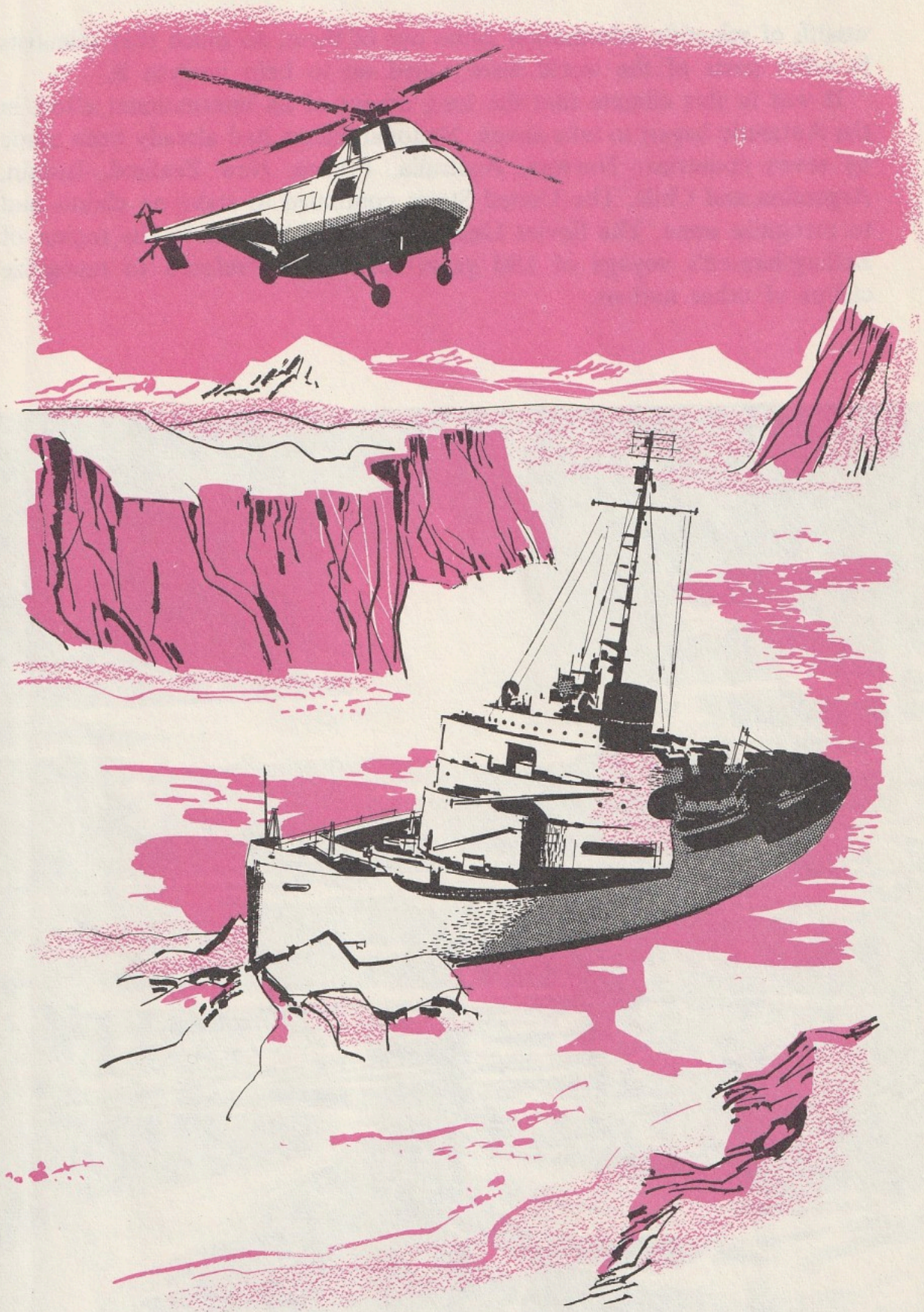
Where Highjump had proved the value of the modern icebreaker in the Antarctic, this new group, called Operation Windmill, set out to test the value of helicopters based from an icebreaker. Although the little egg-beaters had several drawbacks—very limited range and poor performance in bad weather—their use was a great success. With the icebreaker cutting deep into the pack ice, the helicopter could fly off from its deck and quickly reach and return from inaccessible areas to be surveyed.

Although Highjump and Windmill were both short expeditions, a



9. ICEBREAKER "NORTHWIND" AT CAPE HALLET

All icebreakers, such as the U.S.C.G.C. *Northwind* shown here, have special, strengthened hulls to withstand the enormous pressures of ice. Notice the helicopter moored on the afterdeck of the cutter.



wealth of scientific information came out of them, so much that scientists in other parts of the world were called on to help analyse it.

It was in this climate that the long dream of an international effort in the Antarctic began to take shape. National claims had already been made by seven countries: Norway, Australia, France, New Zealand, Britain, Argentina and Chile. The United States continued to stake no claims and to recognize none. The Soviet Union, basing its interest in the region of Bellingshausen's voyage of 150 years earlier, also refused to recognize claims of other nations.





Men erecting a Jamesway hut at the McMurdo Sound base. Behind the base can be seen McMurdo Sound itself covered with ice.

International Co-operation in Antarctica

ACTING ON A SUGGESTION by the American scientist, Lloyd V. Berkner, the International Council of Scientific Unions began planning in 1952 for an International Geophysical Year (IGY)—to begin in July, 1957. Most of the major nations of the world joined in the venture. With special attention focused on Antarctica, more than a dozen nations set up fifty bases on the continent. Among the many scientific objectives were the study of cosmic rays, the influence of the ice mass on global weather, the nature of the brilliant antarctic aurora, oceanographical and atmospheric studies and research from the plateau into the ionosphere during the sunless winter season.

In line with our very short history of *how* the Antarctic continent has been explored over the years—let us look briefly at some of the IGY nations' methods of research. The American effort was called "Operation Deepfreeze". While Admiral Byrd was Officer-in-Charge up to the time of his death, Admiral George Dufek was active commander of the logistic operation; its scientific direction was under the National Academy of Sciences. It was the United States that made the first direct flights to the continent. Aircraft taking off from New Zealand flew nonstop to Antarctica. A fleet of ships led by the newest and largest U.S. icebreaker

steamed into Ross Sea and founded Little America V at McMurdo Sound. Naval engineers built camps and runways and ninety men wintered during 1956–57 in preparation for the IGY. On arrival at the continent the ice-breaker *Atka* found that a ten-mile-wide strip had snapped off the Ross Ice Shelf and broken up into icebergs. Surveyors also found that ice changes along the coast had wiped out the Bay of Whales and Discovery Inlet.

The next year, the Americans set up their Amundsen-Scott station at the South Pole. Dr. Paul Siple was chosen by the National Academy of Sciences Antarctic Committee, under the direction of Dr. L. M. Gould, to be the first scientific station leader at this important and unique station. Siple's first visit to the continent had been made in 1928 with Byrd; at that time Siple was a Boy Scout. Men wintered at the Pole in 1956–57 for the first time in history. But perhaps more significant is the fact that the South Pole station was supplied entirely by air-drop and ski-equipped aircraft. Dogs, equipment and even an eight-ton tractor were parachuted from Globemasters. Later a landing field was built at the Pole. Whenever it could, the United States used aircraft to carry men, dogs, vehicles and supplies to its inland stations. All told, the Americans had 340 men in seven scattered scientific stations during the IGY Winter.

The Soviet efforts were second only to those of the United States. They set up bases on the coast of Queen Maud Land, and later at the Pole of

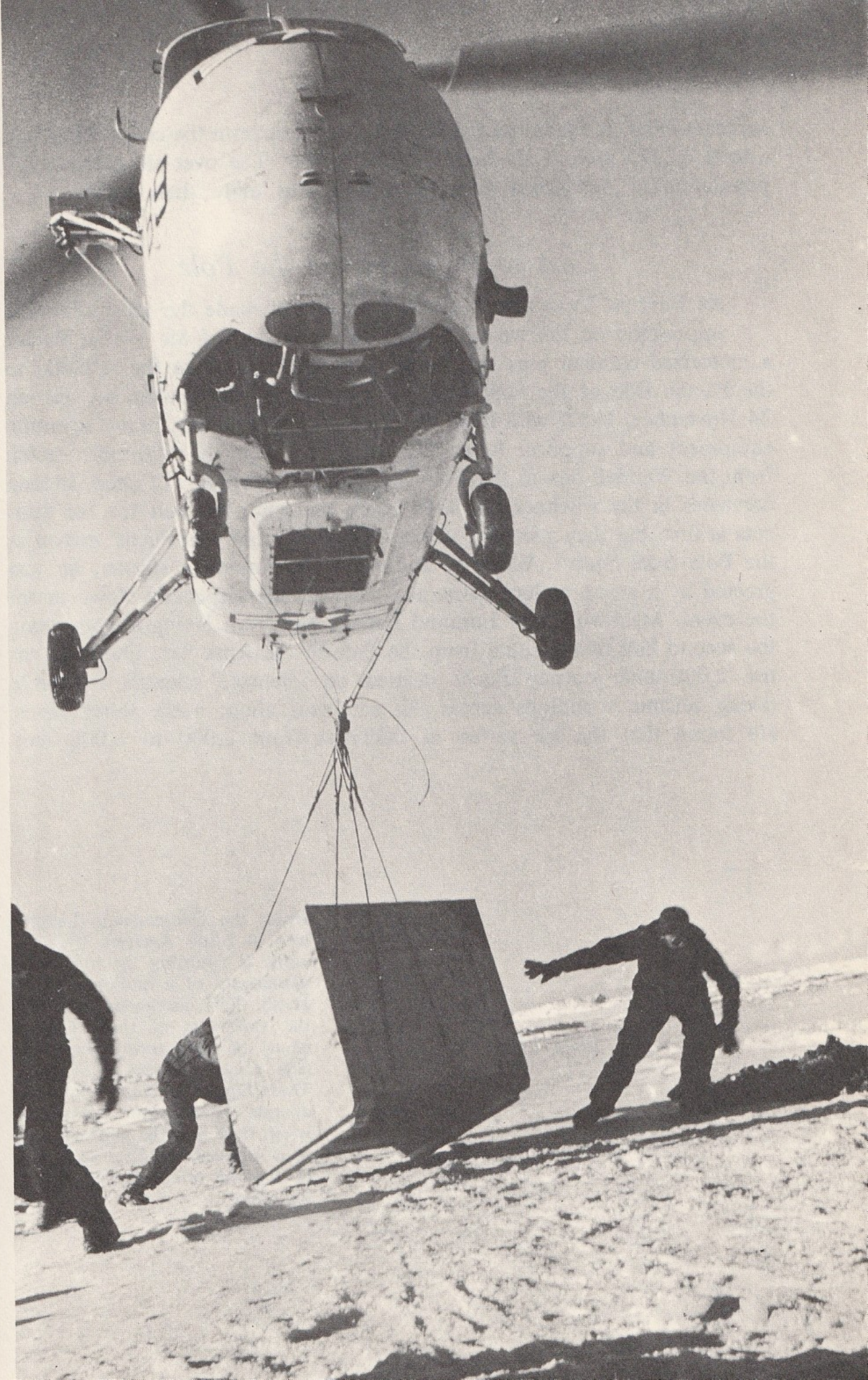


10.

LOCAL BUS SERVICE

A ship's helicopter arrives to take a research team back to base camp, saving valuable hours of travelling time.

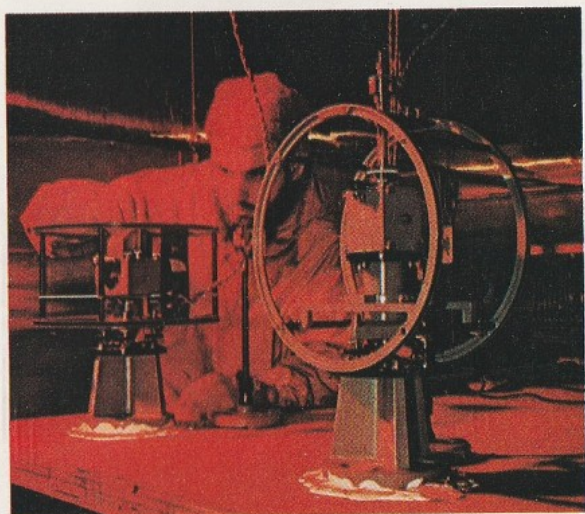
Not all supplies are dropped by Globemasters. Here a helicopter is lifting a crate to be delivered miles away.



Inaccessibility, the point on the continent farthest from the coast. They had a total of 175 men at six bases for the winter. The over-all international population of Antarctica during the IGY was more than 1,000.

East to West Across the Pole

THE BRITISH TRANS-ANTARCTIC EXPEDITION made the most dramatic impression on the world. Under the leadership of Sir Vivian Fuchs, a motorized caravan plus dog teams went overland from the Atlantic to the Pacific side of the continent, via the South Pole. Fuchs set out on 24 November, 1957, with huge "Sno-cat" tractors pulling heavy scientific equipment and supplies. It was the first time that the 600-mile stretch from the Weddell Sea to the Pole was explored. A maze of deep, hidden crevasses in the Filchner Ice Shelf made the going difficult for the Sno-cats at first, but they proved a success. How different was Fuchs' arrival at the Pole from Scott's. When he rode into the American station, he was greeted by a group of journalists and photographers specially flown in for the event! Meanwhile, Sir Edmund Hillary had been laying depots along the second half of the route from the Pole to the Ross Sea. Over the entire 2,000-mile journey Fuchs carried on intensive scientific research, taking seismic soundings across the continent about every thirty miles. He found that the ice varied in thickness from 2,000 to 6,000 feet.



11.

GEOMAGNETIC LABORATORY

Inside the Geomagnetic Laboratory at Little America V a scientist is adjusting the horizontal component of a rapid-run variograph. This instrument measures the variations of three components of the earth's magnetic field over the course of time. These highly delicate instruments operate in a room below the snow; they must be adjusted only in a subdued red light so as not to fog the photographic recording paper.

Scientist makes tour of inspection of surface meteorological instruments. Every three hours, whatever the weather, this check is made by a staff meteorologist.



A Unique Treaty

ONE MAJOR RESULT OF THE IGY PROGRAM was the recognition that the Antarctic research program should continue to capitalize on the investment of time and money. The nations that joined scientific forces during the IGY realized that many years of internationally coordinated scientific research would be required before a reasonable understanding of Antarctica and its influence on the rest of the world could be achieved.

In 1959, the governments of those twelve nations working in the Antarctic drew up a unique treaty. It sets aside Antarctica as a special domain for scientific research. The treaty forbids the dumping of atomic wastes in Antarctica, bans nuclear explosions and allows any nation to investigate the activities and facilities of any other nation at any time. Under the terms of the thirty-year pact, not even a pistol is to be found at any Antarctic base.



Today Antarctica is a populated land, thanks in large measure to the airplane. Here is a drawing of a C-124 Globemaster laden with supplies.

Now—A Faster Tempo

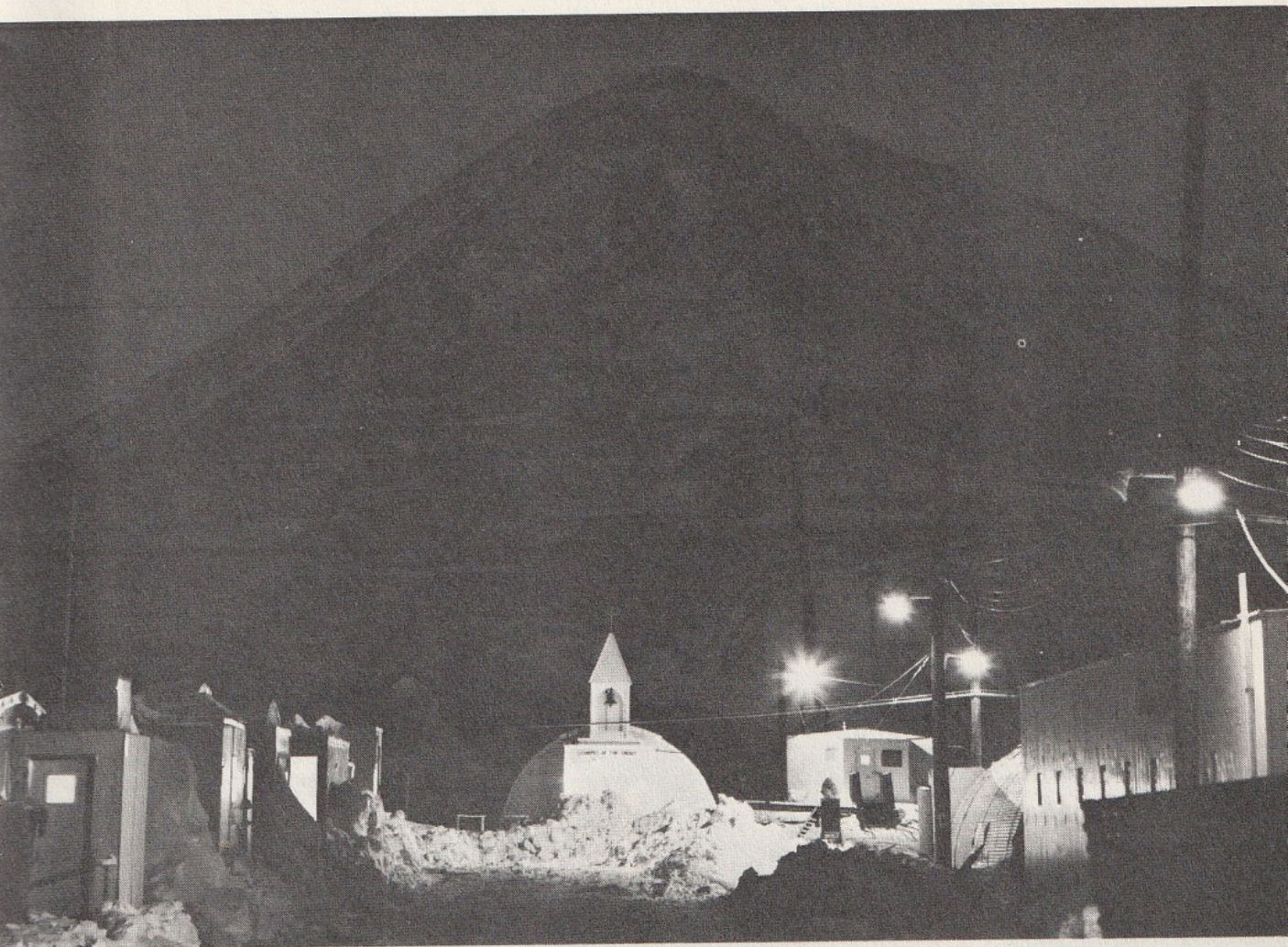
OVER THE PAST DECADE, research has continued at an increasingly quickened pace in the Antarctic. The U. S. Navy has mounted an expedition each year since the end of IGY, and now operates five permanent stations. In addition to the main staging site at McMurdo Sound, scientific stations are located at South Pole, Byrd, Plateau and Palmer on the Antarctic Peninsula. At McMurdo, Antarctica's largest "city"—with nearly a thousand residents in the summer—a nuclear power station has been producing electric power since 1962. In 1966, a 14,000-gallon-per-day salt water distillation plant became operable, making indoor plumbing a reality.

On 18 December, 1966, a group of ten American explorers, led by Nicholas B. Clinch III, climbed the 16,860-foot summit of the Vinson Massif, conquering for the first time Antarctica's highest peak. The team,

including geologists who went along to do research, also climbed five nearby mountains in the interior of Antarctica, 450 miles east of Byrd Station, the nearest human habitation and 1,350 miles east of McMurdo Sound. It was another great "first" for men of adventure.

Scientists in the past decade have come up with evidence that frigid Antarctica and torrid India were once part of a single land mass. Other scientists have brought home specimens of snow whose lead content may bear upon the health of all the world's people. Still others are relating the wastes of Antarctica to the space age. At McMurdo a readout station has been set up for weather satellites and useful information is being ob-

The main street of McMurdo Station as it appears during the four and one-half months of darkness. Pictured is the Chapel of the Snows.

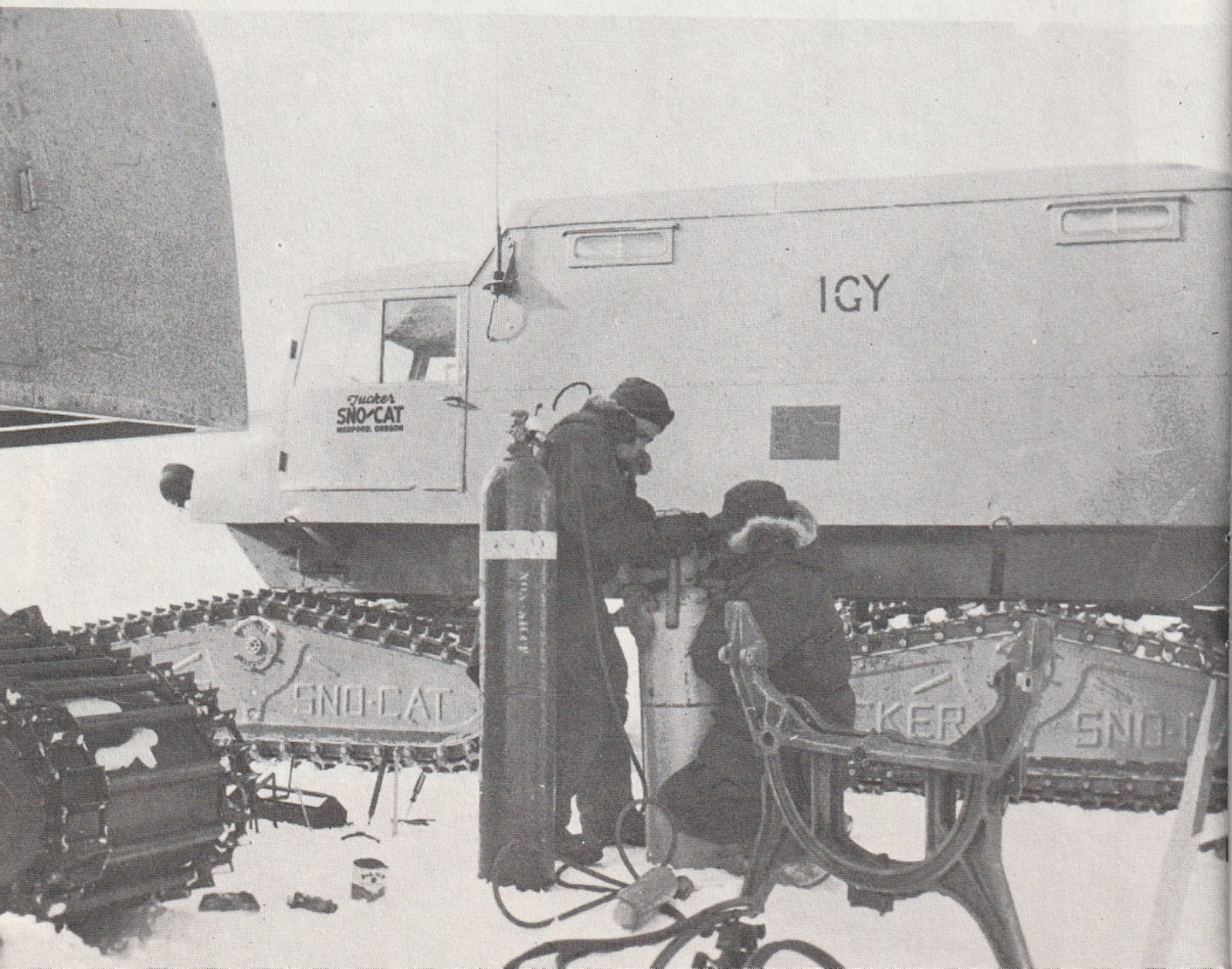


tained about the tricky, quick-changing atmospheric conditions. With the National Aeronautics and Space Administration proceeding toward its goal of landing men on the moon, some of its officials have taken a first-hand look at the hostile environment that man and machine face in the earth's coldest region—hopeful they will learn lessons helpful to moon explorers of the future.

Importance of Antarctica

WHAT IS THERE IN ANTARCTICA OF VALUE? For one thing, the continent has mineral resources comparable to those of other great continents. Traces of some 176 minerals including uranium, copper and petroleum have been found. Further exploration seems to be worthwhile. Less than one per cent of Antarctica has been examined geologically.

When a breakdown occurs in the Antarctic there is no handy service station for quick repairs. The men have to make the repairs themselves in the sub-zero weather.



Measuring the thickness of the ice and discovering the surface formation of the underlying rock requires large charges of dynamite to generate sound signals. An array of geophones is placed in a pattern in the surrounding area to receive the sound signals. Here a hole is being charged with dynamite.



12.

PREPARING TO BLAST

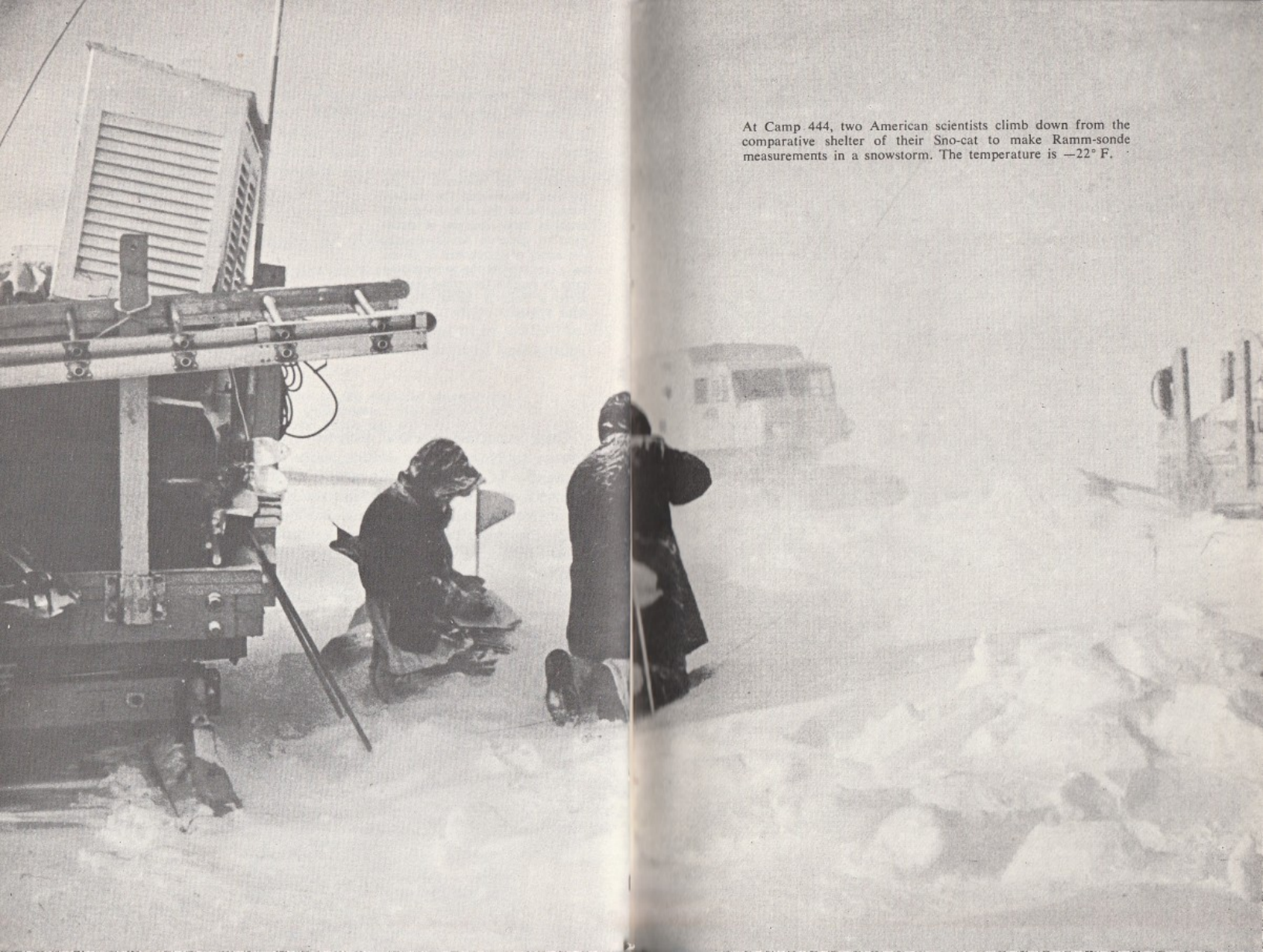
Other economic potential includes hydroponic farming, the use of strange antibiotics in the drifting plants of the Antarctic seas, and the conversion of the enormous quantities of the ever-present plankton into human food. Still another economic use is the establishment in the future of intercontinental air routes and facilities which would greatly reduce flying time from the southernmost countries.

Researchers all over the world realize the important role that Antarctic weather plays in affecting the people living south of the equator. Some aerologists believe its effects are felt in the north as well. Admiral Byrd once called Antarctica the greatest "weather factory" in the world. Not only weather: Antarctica lends itself to the study of the mysteries of aurora australis, ionospheric phenomena, cosmic radiation, glaciology, seismology and geomagnetic problems.

We have come a long way since Captain James Cook first faced the pack ice on his 1774 voyage and wrote that "... there must be some land behind this ice, but if there is it can afford no better retreat for birds or any other animals than the ice itself, with which it must be wholly covered."

Today, only a few air hours away from civilization, Antarctica is influencing the lives of all of us. It now appears that man has come to Antarctica to stay. For years to come, a principal export of this vast continent will be knowledge useful to all.

At Camp 444, two American scientists climb down from the comparative shelter of their Sno-cat to make Ramm-sonde measurements in a snowstorm. The temperature is -22°F .



Some Cold Facts about the Antarctic

Antarctica is the fifth largest continent—5.1 million square miles—equalling the U.S. and Mexico together, or almost twice the size of Australia, and over fifty times the area of New Zealand.

It is the world's highest, windiest and driest continent. The world's lowest temperature, -126.9°F. , was recorded there. The average annual precipitation is only two to four inches of water equivalent. The continent's average altitude is more than one mile.

Due to the earth's centrifugal force, objects weigh more at the South Pole than at the Equator. Five thousand tons of cargo at the Equator weigh about 50,000 pounds more at the Pole.

There are no polar bears or land animals in the Antarctic. Thus, penguins and seal species find haven on the sea ice.

The Antarctic contains about ninety per cent of the world's glacial ice supply. Its melting would raise the surface of the oceans about 200 feet and inundate the seaports of the world.

An atmospheric condition known as "white out" is frequent in the Antarctic. Aviators say it is like flying in a bowl of milk.

In spite of ice and snow, the Antarctic is the home of a large, active volcano, 12,450-foot Mt. Erebus on Ross Island.

The intense cold and sterility of Antarctic air preserves food and materials almost indefinitely. Corned beef cached by a Swedish explorer provided a satisfactory meal for a British expedition forty-five years later. The print on a magazine, too, was readable as ever.

The Antarctic is land surrounded by water, whereas the Arctic is water surrounded by land. This accounts for the colder temperatures of the Antarctic. The South Pole rests on a polar plateau about 10,000 feet high; the North Pole is in the middle of a sea about 10,000 feet deep.

Due to the earth's rotation, ice drifts to the left of the wind in the Antarctic, whereas it drifts to the right in the Northern Hemisphere. Persons who become lost invariably circle to the left in the Antarctic and to the right in the Arctic.

